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ABSTRACT

A series of studies were conducted to determine how Army personnel in Mental Category IV and in other mental categories compare in their job performance and in their overall suitability for military service. Information is provided concerning the demands for reading, arithmetic, and listening skills in four major military occupational specialties. The performance of approximately 1,800 men with Army experience ranging up to 20 years was measured by intensive job sample tests, job knowledge tests, and supervisor ratings. Information about background, personal characteristics, and military experiences was obtained through biographical questionnaires, a battery of published and experimental tests, and Army records. The major findings and conclusions are given in this summary report, which will be followed by several detailed reports on various research phases. (Author)

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Technical Report 71-1

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Effects of Aptitude (AFQT), Job Experience, and Literacy on Job Performance: Summary of HumRRO Work Units UTILITY and REALISTIC

Robert Vineberg, Thomas G. Sticht,
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HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street • Alexandria, Virginia 22314

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TO: ERIC
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400 MARYLAND AVE. S.W.
WASHINGTON, D.C. 20202

1. The research described in this report was part of the work in a series of studies to determine how Army personnel in Mental Category IV and in other mental categories compare in their job performance and in their overall suitability for military service.

2. Job performance in Armor Crewman (MOS 11E), General Vehicle Repairman (MOS 63C), Unit and Organizational Supply Specialist (MOS 76Y), and Cook (MOS 94B) was evaluated by using intensive job sample tests, job knowledge tests, and supervisor ratings. Information concerning the demands for reading, arithmetic, and listening skills was also gathered and compared with skill levels of the men in the MOSs. These data are summarized in the report with special reference to comparisons between lower and higher mental category personnel.

3. This report and others in the series should be of interest to those persons concerned with utilization of personnel, training and training management, and curriculum design, especially as these relate to training of personnel in lower mental categories.

FOR THE CHIEF OF RESEARCH AND DEVELOPMENT:

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16. Abstract

A series of studies were conducted to determine how Army personnel in Mental Category IV and in other mental categories compare in their job performance and in their overall suitability for military service. Information is provided concerning the demands for reading, arithmetic, and listening skills in four major military occupational specialties. The performance of approximately 1800 men with Army experience ranging up to 20 years was measured by intensive job sample tests, job knowledge tests, and supervisor ratings. Information about background, personal characteristics, and military experiences was obtained through biographical questionnaires, a battery of published and experimental tests, and Army records. The major findings and conclusions are given in this summary report, which will be followed by several detailed reports on various research phases.

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The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. HumRRO's mission in work performed under contract with the Department of the Army is to conduct research in the fields of training, motivation, and leadership.

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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FOREWORD

This report presents a summary of the findings of two HumRRO Work Units that have yielded a substantial amount of factual information on the performance of Category IV men in four Army jobs. How well they were doing was compared with how well Non-Category IV men who had equivalent job experience were doing. In addition, each man was given an extensive battery of special tests, and background information on each was recorded from Army records. Relationships between these kinds of data and job performance were computed to determine what factors, in addition to AFQT score and job experience, might predict job performance.

Summary conclusions from these two Work Units and from related HumRRO research are presented in the first chapter of this report. The second and third chapters summarize the results of the two Work Units. Detailed reports of each will appear in a series of HumRRO Technical Reports.

The purpose of this report is to present information as background for the formulation of manpower policy. While the implications of several findings are discussed in order to suggest options for planners, specific recommendations are not made.

A few words about the origins of these research programs are in order. Since the early 1950s, we in HumRRO have done research on various aspects of the relationship between aptitude and learning and between aptitude and performance. In 1955, the effectiveness of a special Army remedial education program for marginal men was examined. Shortly thereafter, studies were begun on the kinds of training techniques most effective with lower aptitude personnel. In 1964, HumRRO participated in the preparation of *Marginal Man in Military Service: A Review*, a publication of the Department of Defense, that brought together most of what was known about the topic at the time. In 1966, we completed a study of the performance of Category IV and Non-Category IV men in Army basic training. Also, at about that time, research was planned in support of the special training and education program (STEP) which had been proposed by the Army.

In the summer of 1966, the Assistant Secretary of Defense for Manpower and Reserve Affairs, Mr. Thomas Morris, invited proposals from several research agencies concerning the military use of marginal manpower. These were to be related to "Project 100,000," soon to be announced by the Secretary of Defense. Among the proposals made by HumRRO was one that resulted in Work Unit UTILITY, given this code name to suggest the major purpose of the work: to determine "the utility" of Category IV men in representative military occupations. Formal work was begun in January of 1967.

As this research got under way, further consultations with OASD (M&RA) resulted in the formulation of Work Unit REALISTIC, the code name suggesting its intent: to determine the importance of REAding, LIStening, and ArithmeTIC in the performance of military jobs for men of various aptitudes. This work began in April 1968. A substantial proportion of the data was gathered from the same men who were studied in UTILITY.

The data from both of these studies are unique in at least three respects: First, the main criteria of job performance are derived from job sample proficiency tests in which soldiers performed tasks representative of each job with real equipment in field settings. Each test lasted from three to five hours. Performance was objectively scored. Second, comparisons between Category IV and Non-Category IV men are made on the basis of pairs of men who are matched for job experience. Third, the very large number of special

tests and items of background information constituted an unusually rich body of information.

It is worth noting that data of this sort are not easy to obtain. The development of the proficiency tests required a substantial amount of research into the job requirements and duties as well as successive trials to develop discriminating and reliable test instruments. The assistance of a team of military specialists was required in this work. The location of subjects in sufficient quantity who could be made available from their military duties required extensive coordination throughout the Army. Major testing took place at three CONUS sites and within the Seventh Army in Europe. Finally, the identification of men who not only had the required military occupational classification but who were actually working at the job entailed detailed review of company rosters and interviews with command personnel.

In the presentation of results on UTILITY and REALISTIC, reference will be made to other related ongoing and planned HumRRO research. In Work Unit SPECTRUM, a basic research program, the relation between learning, teaching techniques, and aptitude—to include the entire "spectrum" of aptitudes from marginal to gifted—is being investigated to yield promising techniques for the development of appropriate training technology. In Work Unit APSTRAT, practical teaching strategies are being developed for men of differing aptitudes. Currently under way at Fort Ord, California, is an experimental course for Army signalmen that employs many new strategies, including peer instruction, which are proving effective with men of low as well as higher aptitudes. In the HumRRO Army Work Program for FY71, there are three units which grow out of the current work. In FOLLOWTHRU, men who were in the UTILITY sample will be followed to determine whether they reenlisted; to assess their performance during a second tour and to relate these findings to data obtained on them in UTILITY. In Work Unit READNEED, techniques are being developed to determine precisely the reading requirements in particular military occupational specialties. Work Unit LISTEN is directed at the development of techniques for improving the ability of men to learn through listening. We found in REALISTIC that many men, particularly of lower aptitudes, depend more on the ear than the eye to obtain job-related information.

In the report which follows, data will be presented on Army subjects. It should be made clear that no official Army position on the findings has been taken and none is implied in the way the findings are presented. The funding of both of these Work Units has been from the Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs), which office has sponsored the work jointly with the Deputy Chief of Staff for Personnel of the Department of the Army. It will be apparent that the purpose of this report is to summarize what has been done and to indicate those relationships among variables which did attain significance as well as the large number which did not. These findings are offered as background information for the formulation of policy about the use of manpower.

Chapter 1 was prepared by the authors of the report with participation by Dr. Howard H. McFann, Director, HumRRO Division 3. Chapter 2 was prepared by Drs. Robert Vineberg and Elaine N. Taylor. Chapter 3 was prepared by Drs. Thomas G. Sticht and John S. Caylor.

HumRRO research for the Department of the Army is conducted under Contract DAHC 19-70-C-0012. Training, Motivation, and Leadership research is conducted under Army Project 2Q062107A712.

Meredith P. Crawford
President
Human Resources Research Organization

SUMMARY AND CONCLUSIONS

Military Problem

In October 1966 the Department of Defense began accepting men with lower aptitudes as part of a massive social experiment designed to make effective soldiers of men who had generally been considered marginal in ability and to provide them with education and training necessary for productive and useful lives as citizens. In Project 100,000, the aim was to take into the Armed Forces, each year, 100,000 men who would otherwise have been ineligible for military service. An important consideration was that minimum standards of military performance be maintained and that the overall effectiveness of the services not be diminished.

While evidence is available that sizable numbers of men with low-aptitude scores can perform effectively, there has never been a systematic study that identified the characteristics of marginal men who are suitable and also the kinds of jobs best suited to them.

Approach

Two research studies, HumRRO Work Units UTILITY and REALISTIC, were undertaken to obtain information on the performance and characteristics of marginal men.

The objectives of the research in Work Unit UTILITY were to determine how men in Mental Category IV and men in other mental categories compare in the performance of their jobs. A further objective was to identify characteristics associated with successful performance of jobs and to determine what background and other nonintellectual measures might prove useful in screening, classifying, and assigning such men.

To accomplish these objectives, the performance of job incumbents in four major military occupational specialties (MOSs) was studied: Armor Crewman (MOS 11E); General Vehicle Repairman (MOS 63C); Unit and Organizational Supply Specialist (MOS 76Y); Cook (MOS 94B). Performance was evaluated by using Job Sample tests in which actual work tasks were performed, paper-and-pencil Job Knowledge tests, and Supervisor Ratings. In addition, numerous data were obtained on personal and background characteristics and on a variety of cognitive tests. Groups of men from Mental Category IV were selected and matched with men from the higher Mental Categories with respect to number of months spent in the job. The performance of these high- and low-aptitude men was compared.

The objectives of Work Unit REALISTIC were to provide information concerning the demands for reading, arithmetic, and listening skills in MOSs composed of large numbers of men, including the "new standards" men of Project 100,000. Also, information was sought on adjusting to the needs of men of low literacy levels through remedial training or modification of job demands.

Relationships were examined between the reading, listening, and arithmetic skills of job incumbents and the performance of these men on four different indices of job proficiency. The job incumbents were in the same MOSs studied in Work Unit UTILITY, and data on three of the four different measures of job proficiency were collected in the UTILITY study. A fourth index of proficiency consisted of job-related reading tasks—tests constructed from printed materials used by job incumbents in three MOSs: General

Vehicle Repairman, Unit and Organizational Supply Specialist, and Cook. The materials selected for the reading task tests were identified during interviews with job incumbents in the MOSs. Information was obtained concerning a man's job-related reading, listening (i.e., acquiring information by asking others), and arithmetic behaviors. In addition, reading difficulty levels of the materials cited in the interviews were determined and compared with the reading skill levels of the men in the MOSs.

Major Findings and Conclusions

(1) In general, AFQT is related to job performance, although considerable overlap exists between Category IV and Non-Category IV men.

(2) In a comparison of the performance of Negroes and Caucasians, no relationship was found between race and performance.

(3) Supervisor Ratings (Commander's Evaluation Report) were found to bear only a slight relationship to job proficiency as measured by Job Sample and Job Knowledge tests.

(4) After 30 months of job experience, approximately 90% of the job incumbents performed at the upper levels of the performance distribution.

(5) No relationship was found between AFQT score and the grade reached in the Army.

(6) In two of the jobs studied, Repairman and Supply Specialist, the average difficulty level of printed job materials exceeded the average reading ability of both high- and low-aptitude men. The higher a man's reading ability, the more likely he was to use printed job materials. The lower a man's reading ability, the more likely he was to ask others (listen) for the job information rather than to read the job-related materials. Also, a large number of men with poorer reading ability reported that they would prefer to learn by listening rather than by reading; some evidence indicates that they might learn prose materials as well by listening as by reading. Thus, listening as a literacy skill takes on special meaning for inept readers.

(7) Reading ability, listening ability, and arithmetic skill were all found to be related to job proficiency as measured by Job Knowledge tests and Job Sample tests. In addition, reading ability was found to be more highly related to scores on the job reading task tests than was AFQT.

(8) Literacy demands were found to be highest for Supply Specialist, next highest for Repairman and Armor Crewman, and least for Cook. To provide a reasonable match between reading ability and job requirements, suggested minimal levels of reading grade level are: Supply Specialist—9.0, Repairman and Armor Crewman—8.0, and Cook—7.0. A sixth grade level of arithmetic would seem to suffice for performance in these jobs.

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Effects of Aptitude (AFQT), Job Experience,
and Literacy on Job Performance:
Summary of HumRRO Work Units
UTILITY and REALISTIC

Chapter 1

SYNOPSIS OF HumRRO WORK UNITS UTILITY AND REALISTIC WITH MAJOR FINDINGS AND POLICY AND RESEARCH IMPLICATIONS

This report summarizes the results of a series of studies that were conducted to determine the job proficiency of men in four major military occupational specialties and to identify background and personal characteristics related to effective job performance. The jobs selected provide representation of a broad range of job types and task complexity. Emphasis has been upon the evaluation of relationships of mental aptitude, literacy skills, and job experience to job proficiency. These studies provide information relevant to policy decisions concerning: Personnel accessions, classification procedures, training strategies most likely to optimize job proficiency, and means of matching men and job support materials for greater system effectiveness.

The studies reported here were performed as HumRRO Work Units UTILITY and REALISTIC. Both of these Work Units were sponsored by the Office of the Secretary of Defense/Assistant Secretary of Defense (Manpower and Reserve Affairs) and by the Department of the Army, Deputy Chief of Staff for Personnel.

In this Chapter a brief synopsis of the two Work Units is given, followed by a presentation of the major findings with their policy and research implications, closing with a general discussion of the implications of these and other research studies as they relate to selection, assignment, reenlistment, and training of men in military jobs. The research and findings of the Work Units are described in more detail in Chapters 2 and 3 of this report.

Work Unit UTILITY: Study of the Job Performance of Men in Lower Mental Categories

The objectives of the research in Work Unit UTILITY were to determine how men in Mental Category IV and men in other mental categories compare both in the performance of their jobs and in their overall suitability for military service. A further objective was to identify characteristics associated with successful performance of jobs and to determine what background and other non-intellectual measures might prove useful in screening, classifying, and assigning such men.

To accomplish these objectives, the performance of job incumbents in four military occupational specialties (MOSs) was studied: Armor Crewman (MOS 11E); General Vehicle Repairman (MOS 63C); Unit and Organizational Supply Specialist (MOS 76Y); Cook MOS 94B). Performance was evaluated by using Job Sample tests in which actual work tasks were performed, paper-and-pencil Job Knowledge tests, and Supervisor Ratings. In addition, numerous data were obtained on personal and background characteristics and on a variety of cognitive tests. Samples of men from Mental Category IV were selected and matched with men from the higher Mental Categories with respect to number of months spent in the job. The performance of these high and low aptitude men was compared.

Work Unit REALISTIC: Determination of Reading, Listening, and Arithmetic Skills Required for Major Military Occupational Specialties

Taking cognizance of the literacy problems to be encountered with the Project 100,000 personnel, manpower planners initiated Work Unit REALISTIC. The objectives were to provide information concerning the demands for reading, arithmetic, and listening skills in MOSs composed of large numbers of men, including the "new standards" men of Project 100,000. Also, information relevant to accommodating men of low literacy levels through remedial training or modification of job demands was sought.

Relationships were examined between the reading, listening, and arithmetic skills of job incumbents and the performance of these men on four different indices of job proficiency. The job incumbents were in the same MOSs selected for study in Work Unit UTILITY. Of the four different measures of job proficiency, three were collected in the UTILITY study. A fourth index of proficiency consisted of job-related reading tasks—tests constructed from printed materials used by job incumbents in three MOSs: General Vehicle Repairman, Unit and Organization Supply Specialist, and Cook. The materials selected for the reading task tests were identified during interviews with job incumbents in these MOSs. During the interview, information concerning a man's job-related reading, listening (i.e., acquiring information by asking others), and arithmetic behaviors were obtained. In addition, reading difficulty levels of the materials that had been cited in the interviews were determined and compared with the reading skill levels of the men in the MOSs.

Additional work on REALISTIC involved considerable laboratory and literature research to obtain information of potential use for reducing gaps which exist between an individual's literacy skill level and the demands of his job for these skills. Much of the laboratory work focused on the study of listening as a substitute for reading, and is reported in a HumRRO Technical Report.[1] A source book for the design of training and job performance aids is being compiled, based on the literature research. Only the policy and research implications of this laboratory and literature research are discussed in this report.

MAJOR FINDINGS AND POLICY AND RESEARCH IMPLICATIONS

Before presenting the findings, one characteristic of these studies should be emphasized. Because the focus of the studies was on actual job performance, the personnel tested were all working on a continuing daily basis in their jobs. Necessarily the studies do not include men who (a) failed in training, (b) were removed from their jobs because of unsatisfactory performance, (c) were removed from active duty because of misbehavior, or (d) were promoted out of their jobs.

1. Information from the UTILITY research indicated that while in general AFQT is related to job performance, considerable overlap exists between Category IV and Non-Category IV men. Also, with time, an increasing proportion of men at all levels of AFQT appear in the upper ranges of the performance distribution. The data suggest the potential loss of a sizable number of good performers if entry requirements were modified to exclude from service those men with AFQT scores below 20.

2. Beyond 30 months of job experience there is a clear and stable floor of performance which could be used to define minimum acceptable performance. If one considers only performance as a criterion of suitability for military service, and further

[1] Thomas G. Sticht. *Learning by Listening in Relation to Aptitude, Reading, and Rate-Controlled Speech*, HumRRO Technical Report 69-23, December 1969.

assumes that it is reasonable to invest a first tour in men of lower aptitude who are likely to perform effectively thereafter, then a procedure would be desirable for screening out those men who do not rise at least to this minimum level after an initial opportunity to acquire job proficiency. It is proposed that such screening could be accomplished through the administration of job knowledge tests at the time of a man's first reenlistment. Further, since general military performance rather than job proficiency per se should be used as a criterion of a man's suitability for reenlistment, it is suggested that the screening could be based jointly on a man's *Job Knowledge test* score and on his record of conduct in the military prior to the time of reenlistment.

3. Of the many personal characteristics that were examined in an attempt to identify predictors of job sample performance for Category IV men, the most promising was a man's listening test score. Further research should be considered on the possible use of a listening test as a predictor of job performance for Category IV men.

4. Performance of Negroes and Caucasians was compared. Negroes appear to perform as well as Caucasians. This finding is particularly significant if, as some have speculated, the number of Negroes relative to Caucasians would increase in an All-Volunteer Army.

5. Supervisor Ratings (Commander's Evaluation Report) were found to bear only a slight relationship to job proficiency as measured by Job Sample and Job Knowledge tests. Since Supervisor Ratings have been designed to measure more global aspects of behavior, it should be recognized that when decisions are based on them (e.g., awarding Proficiency Pay), it may be general personality characteristics that are being assessed rather than job proficiency.

6. Since, after 30 months of job experience most men perform at the upper levels of the performance distribution, instructional systems that offer promise of bringing men to these levels in a shorter time should be considered. The training literature contains a variety of techniques whose goal is to maximize learning efficiency. These range from the use of systems analysis procedures in developing and specifying training objectives and content, to the use of specific techniques within training, such as individually paced instruction and the application of systems of rewards (contingency management). HumRRO's Work Unit APSTRAT[2] provides a model incorporating many of these instructional innovations. (See last paragraph of this chapter for more detail.)

7. Work Unit UTILITY was a cross-sectional study rather than a longitudinal one. A cross-sectional design does not provide assessment of the same men at different periods in their Army careers. Thus the superior performance of men with more job experience found in UTILITY could reflect the interaction of learning and a variety of selective processes.[3] Work Unit FOLLOWTHRU, to be undertaken by HumRRO during FY 71, will follow up UTILITY subjects who have remained in the Army. FOLLOWTHRU should provide the more definitive evidence regarding questions pertaining to the rolls of learning and selection.

Work Unit UTILITY research showed no evidence of a relationship between AFQT and the grade reached in the Army. The evidence strongly suggests that promotion is primarily related to job longevity. In that men in all AFQT levels reached supervisory positions with equal frequency, a question of considerable importance is how men at these different levels of aptitude compare in their supervisory roles. Such an evaluation

[2] HumRRO Work Unit APSTRAT—Training Strategies and Incentives Appropriate to Different Aptitude Levels for Selected Army Training Courses.

[3] With the UTILITY data, however, it is possible to obtain some information regarding this question. A few personal characteristics were found related to superior performance. However, the correlations of these variables with time in the job were examined and found negligible. This suggests that learning rather than selection is producing the greater proficiency of men with more job experience.

could be of particular value in the event of an All-Volunteer Army. With such a force structure, many have speculated that there would be greater numbers of low aptitude men occupying senior enlisted positions.

9. Concerning literacy demands of jobs, information from Work Unit REALISTIC indicated that, where manuals were used in conjunction with the job sample performance tests, performance tended to improve. Concerning the use of manuals, additional information from REALISTIC indicated that, with the exception of the Cook's MOS, the reading difficulty level of printed job materials far exceeded the reading ability of both high and low aptitude men. Also, the difficulty level of the materials was related to the frequency with which they were used on the job. If the materials were too difficult, men tended not to use them. However, the greater a man's reading ability, the more likely he was to use printed job materials, even the more difficult materials. Thus it appears that the increased use of job reading materials, and hence better job performance, might be stimulated either by upgrading the reading skills of personnel through literacy training, and/or by reducing the difficulty levels of materials by the provision of systems engineered job aids.

10. Reading ability was found to be meaningfully related to job proficiency when measured by performance on job reading task tests, job knowledge paper-and-pencil tests, and job sample tests. Reading test score was more highly related to proficiency on job reading tasks than was AFQT. For the Job Knowledge and Job Sample proficiency tests, AFQT and reading test scores predicted proficiency about equally as well. Because the reading test predicts proficiency on job reading tasks better than the AFQT does, and because the reading test identifies skill levels in a way to suggest what might be done to remedy a man's skill level, rather than to simply screen him in or out of a job, as the AFQT does, consideration could be given to replacing, or supplementing, the screening instrument (AFQT) with more diagnostic, skills-oriented instruments. Such instruments could serve both as screening tools and as tools to indicate how much remedial training a man might require in some literacy skill area (reading, arithmetic, listening, writing, speaking) to improve his job proficiency and opportunities.

11. Listening ability was related to job proficiency when measured by either job knowledge or job sample performance tests. Additional findings[4] showed that (a) Category IV personnel indicated that they obtained almost three-fourths of their information by listening; (b) one-fourth of a sample of some 300 men reported that they preferred to learn by listening rather than by reading (this figure rose to 49% for very poor readers); (c) a sample of high (Non-Category IV) and low (Category IV) aptitude men learned prose material as well by listening to tapes as by reading; and (d) men interviewed on-the-job reported many instances of listening for information, and the frequency of listening relative to reading was higher for poorer readers in MOSs where reading materials were most difficult. Because of the importance of listening, research is needed to study the listening process further and to attempt to improve listening/thinking skills. Such a project, Work Unit LISTEN,[5] is underway at HumRRO Division No. 3 as a follow-up to Work Unit REALISTIC.

12. Arithmetic skill was highly related to reading and AFQT and to job proficiency when measured by either Job Knowledge or Job Sample tests. While arithmetic skills showed some promise as a predictor of job performance, interviews with job incumbents in the Repairman, Supply Specialist, and Cook fields indicated very little actual use of

[4] Thomas G. Sticht. *Learning by Listening in Relation to Aptitude, Reading, and Rate-Controlled Speech*, HumRRO Technical Report 69-23, December 1969.

[5] HumRRO Work Unit LISTEN—Development of Automated Programs to Improve Listening Skills Required in Army Jobs.

arithmetic on the job. Overall, demands for arithmetic skills did not exceed what is ordinarily taught in the first six grades in school.

13. Literacy demands were found to be highest for Supply, next highest for Repairman and Armor Crewman, and least for Cook. If remedial training is given with the aim of providing a closer match between a man's ability and job requirements, suggested targeted grade levels of reading skills are: Cooks—7.0, Armor Crewman and Repairman—8.0, and Supply—9.0. Since the requirements differ from job to job, remedial training would appear most effective when geared toward a specific job. General, non-job-related literacy training geared as it is presently in the Armed Services to a uniform 6.0 grade level, would appear to offer minimal efficiency as far as job proficiency is concerned. Use could be made of diagnostic literacy tests applicable to a job area selected by the man prior to his enlistment, to identify both minimal enlistment skills, and to place the man at some position relative to the targeted reading level for the job area. Upon accession, men deficient in job-related literacy skills could be provided with remedial training, using job-relevant reading, listening, and arithmetic materials, to improve their job proficiency and general military suitability.

14. Literature research in REALISTIC has indicated that, where design of job materials is concerned, considerable evidence indicates that properly designed job manuals can enable the less experienced and less literate men to achieve acceptable job performance, with fewer errors and little or no loss in time, and with much less training than usually given. The approach to manual design should be a "systems" or "task analytic" approach, with the aid pre-tested on the prospective user. If materials were redesigned to facilitate job performance of men in the MOSs studied in REALISTIC, then men having literacy skills below those identified (12, above), could be expected to use the materials and to perform more effectively while receiving remedial literacy training to permit them to move into higher level jobs where the use of general military publications would be necessary.

15. Because of the moderately high correlations of reading skill with Job Knowledge, care must be exercised to insure that, in fairness to incumbents, if their elimination or retention or promotion is made contingent to a large degree upon job knowledge test performance, then formalized procedures should be implemented to insure that men have the opportunities to acquire the job knowledge and the literacy skills required to take the test, whether these be reading, listening (if the test is orally presented) or arithmetic, or other language/communication skills. If men of lower literacy skills are accepted into service, then their later job security should not be contingent upon the acquisition of higher skill levels unless formal programs are available and emphasized during the early career period. This would seem to be of even greater importance if the manpower requirements are to be filled on the basis of a zero dependency on the draft.

DISCUSSION

This discussion incorporates the findings of Work Units UTILITY and REALISTIC with information available from HumRRO Work Units SPECTRUM and APSTRAT in order to present a more integrated statement of implications for personnel policy.

SELECTION AND ASSIGNMENT

If the manpower pool were composed of a large number of high aptitude personnel who were attracted to the military, then the use of general aptitude tests as selection devices would be quite effective. By admitting only those persons who score high on

aptitude tests, it would be anticipated that fewer disciplinary problems would arise; fewer training problems would be encountered and training costs would be reduced; in addition, initial levels of job performance would be higher. Even so, a fair number of high aptitude persons would be admitted who do not perform effectively.

However, with the broad range of AFQT which *is* characteristic of the population available, there is considerable overlap among AFQT groups in performance during training and subsequently in the job. Consequently, those men who would be excluded from the military on the basis of their low AFQT scores include a considerable number of men who perform well.

Given the relatively moderate relationship between AFQT and performance and the limited amount of diagnostic information provided by such a general aptitude test, it is desirable to consider other types of instruments which, in addition to screening at least as well as the AFQT, are better suited for providing information about specific strengths and weaknesses that focus more directly on the kinds of remediation that may be necessary. If diagnostic instruments were adopted for use in conjunction with, or in lieu of, the AFQT, they could be used to determine a person's entry level skills, knowledge, and interests. Such information could be utilized during the classification process and in determining the training required as well as the remediation needed. Examples of ways of presenting such material so that it would be useful to policy makers are presented in some detail in Chapters 2 and 3 (see Figures 2-6 and 3-5 for examples). Such information would be useful for establishing reenlistment policies as well as for initial entrance into the service.

If adopted, diagnostic instruments should be selected on the basis of their relevancy to families or clusters of jobs.[6]

REENLISTMENT

The findings from these studies indicate both the desirability and the feasibility of developing and employing Job Knowledge tests to establish reenlistment elegibility. Screening tests designed for this purpose should assess only those knowledges directly required in the performance of the job. Test items should be designed to match the literacy level of job incumbents. As discussed in (2) above under Major Findings, it is anticipated that such a knowledge test would be employed in conjunction with the man's record of conduct.

TRAINING

Data from HumRRO's Work Unit SPECTRUM showed that no more than 3% of the students in Combat Support Training Courses with AFQT scores of 31 or higher were recycled for academic deficiencies. In contrast, as many as 12% of the students with AFQT scores between 16 and 30, and 25% of those with AFQT scores between 10 and 15, were academic recycles. It was evident that every effort should be made to identify training procedures which are maximally effective with lower aptitude men.

[6] An excellent example of a system of clustering has been provided by DCSPER, D/A in the Army Functional Specialties System (ARFS). If the AFRS concept were coordinated with the system employed by the U.S. Employment Agency (using the Dictionary of Occupational Titles) a man's military experience could then be directly related to civilian occupations both at the beginning and at the termination of service.

In Work Unit SPECTRUM it was found that method of instruction was critical for low aptitude individuals. Using the conventional lecture-demonstration paradigm, marked individual differences in reaching a standard of proficiency were observed with learning taking up to five to six times as long for the low aptitude individual as for men with AFQTs between 90 and 100. However, it was found that instructional methods that emphasized considerable structure in the learning situation and the presence of a living instructor to provide almost constant prompting and feedback were essential ingredients in the efficient training of low aptitude men.

The data from Work Unit UTILITY further affirm the importance of direct experience. The effects of job experience upon job performance were clearly demonstrated.

Further evidence of the desirability of such an approach to training can be found in HumRRO's Work Unit APSTRAT. In APSTRAT a training system featuring peer instruction in a functionally relevant job-simulated context was developed. The model emphasizes task performance, individualized instruction, mastery to a fixed criterion, and rigorous quality control. The program takes a man through a sequence of first observing performance of a task, then learning the task, next displaying mastery of the task in a performance test situation, and finally serving as an instructor for a student in the earlier observation and learning phase of the sequence. Mastery of each individual learning task, regardless of AFQT, is required and has been shown attainable with this system of instruction. The APSTRAT concept is currently being recommended for wider implementation throughout the Army by the Volunteer Army Task Group.

Such findings are compelling: the maximization of hands-on experience, the performance of job-simulated tasks during training, and the utilization of on-the-job training wherever possible should lead to heightened performance in a shorter time.

Chapter 2

PERFORMANCE IN SELECTED ARMY JOBS BY MEN AT DIFFERENT APTITUDE (AFQT) LEVELS—WORK UNIT UTILITY

Work Unit UTILITY, initiated in January 1967, was designed to provide information about the performance and characteristics of marginal men in the Army. It had two major objectives. The first was to find out how men in Mental Category IV and in other mental categories compared in the performance of selected Army jobs. These comparisons were to include analyses of tasks where greater and lesser degrees of competence might be displayed.

The second objective was to identify different factors associated with satisfactory performance in different mental category groupings. The intent was to explore both the role of a man's background and personal characteristics and his more general Army experience (such as the length of time he has spent in the job) as they relate to performance.

The following criteria were used to identify jobs where performance would be studied:

(1) The jobs, taken together, should cover as broad a range as possible of job types and task complexity.

(2) Insofar as possible, jobs should have counterparts in civilian occupations to maximize the likelihood of research findings having applicability beyond the military setting.

(3) Each job should have relatively large numbers of men assigned to it within the Army so as to provide an adequate sample of men for the study. This would also increase the practical use of any research findings that might prove to be specific to the job studied.

(4) Jobs should be selected in which reasonably large numbers of lower aptitude men are assigned.

(5) Insofar as possible, jobs should be chosen that have counterparts in each military service.

Five Army jobs were selected: Armor Crewman, MOS 11E; General Vehicle Repairman, MOS 63C; Unit and Organizational Supply Specialist, MOS 76Y; Cook, MOS 94B; and Medical Specialist, MOS 91B.

Armor Crewman is a machine-ascendant job consisting principally of sequences of interaction between a man and a weapon system. Tasks are largely procedural. It is the only MOS selected that did not have counterparts in the other military services or in civilian occupations. Repairman is a mechanical maintenance job requiring diagnostic and interpretive skills. Supply is a clerical job calling for the coordination and recording of information. Cook is a job having as its primary requirement the recognition of standards and precision in meeting them. Medical Specialist is a man-ascendant job in which proceduralized tasks are directed towards the processing and treatment of individuals.

In each job, proficiency was measured by using intensive Job Sample performance tests, conventional multiple-choice Job Knowledge Tests, and Supervisor ratings. The Job Sample Tests, of 3-5 hours duration, are considered the primary measure of job capability. They were comprised of a series of subtests, each requiring the performance of an entire task with a natural beginning and ending as it would ordinarily occur in the job.

Tasks included in the Job Sample Tests covered a range of difficulty and frequency of occurrence in the job.

Data on personal characteristics, including background and demographic information, were collected from military records and through the administration of biographical questionnaires and a variety of published and experimental paper-and-pencil instruments.

To insure that job incumbents had been exposed to the fullest range of job demands in their MOS, Armor Crewmen, Repairmen, and Supply Specialists were tested in TO&E units in CONUS and USAREUR. Cooks were tested in TO&E units in CONUS and at Fort Ord, California. Medical Specialists were tested at Army Hospitals in CONUS.

At each location where data collection occurred, pairs of men were selected for testing. Each pair included one man in Mental Category IV (lower aptitude, AFQT of 10-30) and one in Mental Categories I - III (higher aptitude, AFQT greater than 30, also referred to as Non-Category IV in this report). In an effort to insure equal amounts of job exposure for the Category IV and Non-Category IV samples, pair members were matched for the amount of time they had been in their jobs. Only men who were working on a continuing daily basis in the selected MOS were studied. The sample included men in each MOS with up to 20 years of job experience. The total number of men tested is shown in Table 2.1. In order to provide representation of subjects with more than two years of job experience, the selection of Category IV subjects was not limited to Project 100,000 acceptees. Approximately 15% of the men in Mental Group IV came from Project 100,000.[1]

Table 2.1

Number of Men Tested in Work Unit UTILITY

Location	Armor Crewman	Repairman	Supply Specialist	Cook	Medical Specialist
1st Armored Division	28	64	56	66	–
2nd Armored Division	62 62	108	90	100	–
5th Infantry Division (M)	52	224	114	–	–
4th Armored Division	242	–	150	–	–
Fort Ord	–	–	–	214	–
Army Hospitals	–	–	–	–	266
Total	384	396	410	380	266

The remainder of this section contains a summary of the major study findings. It includes the results of all criterion testing in Armor Crewman, Repairman, Supply Specialist, and Cook[2]; a description of those personal characteristics found to be related to performance criteria; analyses of the job duties of men at different AFQT levels; a comparison of the performance of Negroes and Caucasians; and a comparison of the

[1] A small number of Category V personnel (AFQT less than 10) in the sample are included with Category IV personnel in analyses and discussion.

[2] Information about the Medical Specialist is not included in this summary report. Job specialization in this MOS was found to be considerable. Sampling procedures and analysis of these data differed from those followed for the other four jobs, and for this reason information on this MOS will be reported separately.

performance of draftees and enlistees during the first two years of service.[3,4] Detailed information about the research and a complete presentation of the findings is being published by HumRRO in a series of technical reports:

Performance in Five Army Jobs by Men at Different Aptitude (AFQT) Levels:

1. Purpose and Design of Study.
2. Development and Description of Instruments.
3. Comparison of Men With Different Amounts of Job Experience.
4. Relationships Between Literacy Variables and Performance Criteria.
5. Relationships Among Performance Criteria.
6. Performance of the Medical Specialist.

Performance on Job Sample Tests

Job Sample data are examined as they vary with AFQT levels and months of job experience (MOJ). To provide a picture of the changing pattern of scores across the broad range of job experience and to show the considerable overlap of the Category IV and Non-Category IV distributions, a scatter plot of individual scores on the Repairman Job Sample Test is presented in Figure 2.1. The general pattern of scores shown in this Figure is characteristic of the other jobs.

In each MOS there is great variability among men in both the IV and Non-IV mental categories during the first 30 months of job experience. In particular there are both Category IVs and Non-Category IVs who achieve scores in the upper part of the distribution. The major change during this period is a decrease in the occurrence of low scores. After 30 months the majority of scores fall within a restricted range at the upper end of the distribution, with a rather clear and stable floor of performance being evident. While these changes presumably reflect the effects of increasing job experience, it must be noted that this pattern may represent some composite of the effects of job experience and of selective reenlistment and reassignment processes. In a cross-sectional study, such as this one, it was not possible to isolate the effects of selection.[5]

HumRRO Work Unit FOLLOWTHRU, to be initiated during FY 1971 will identify men in the UTILITY sample who have reenlisted after their first tour in the Army. Criterion scores and other characteristics of this group will be compared with the group which has separated. FOLLOWTHRU should provide more conclusive evidence regarding questions of learning or selection.

Mean Job Sample Scores for three AFQT levels (Low IV, High IV, and Non-IV) and six months-on-job (MOJ) levels are plotted in Figures 2.2—2.5.

[3] Analysis of the effects on job performance of different types of training was not possible. It was not feasible to control sampling for this variable. Also, as men remained in their jobs longer, a wide variety of different training experiences intervened. The effects of a specific type of training could not, therefore, be studied.

[4] A gross measure of general suitability, based upon a count of misconduct entries found in each man's permanent record, was included in the study. No differences with respect to AFQT were found using this measure. This lack of relationship, however, is quite inconclusive. The index of misconduct suffered from a variety of limitations. For example, of necessity the study included only those men who were available for duty. Any man who was AWOL, confined to the stockade, or otherwise unavailable as a subject, could not be included. This restriction considerably reduced the incidence of misconduct found. No further discussion of misconduct is contained in this report.

[5] Within the UTILITY data, however, some information bearing on this question was available. Only a few personal characteristics (e.g., AFQT) were found related to superior performance and the correlations of these variables with time in the job were examined and found negligible. Within the UTILITY data, learning rather than selection was evidenced by improvement of proficiency within the first 18 months. This tends to suggest that learning is responsible for the greater proficiency of men with more job experience.

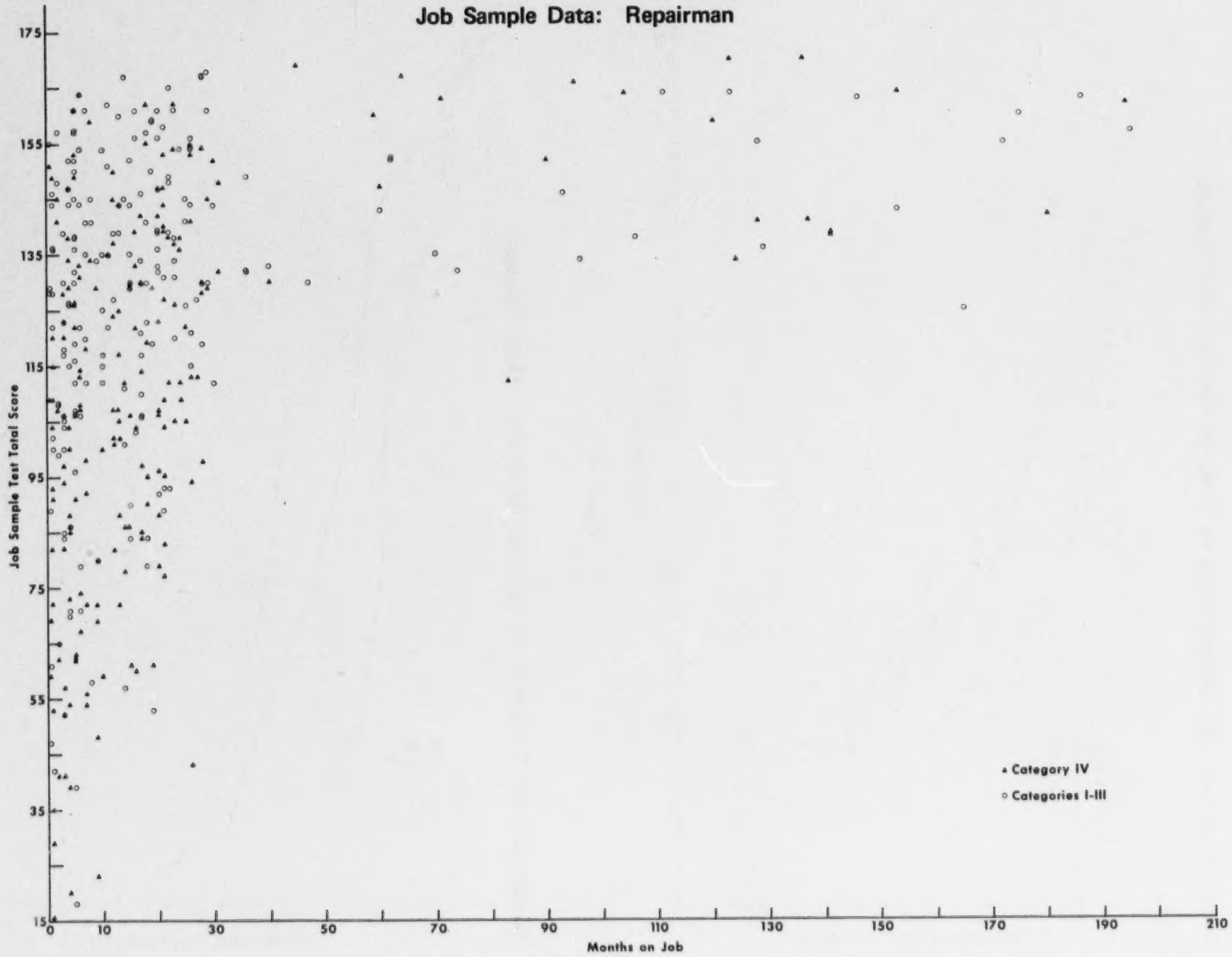

Job Sample Data: Repairman
Job Sample Test Total Score
175
155
135
115
95
75
55
35
15
0
10
30
50
70
90
110
130
150
170
190
210
Months on Job
▲ Category IV
○ Categories I-III

Figure 2.1

Armor Crewman's Job Sample Score by Time on Job for AFQT Groups

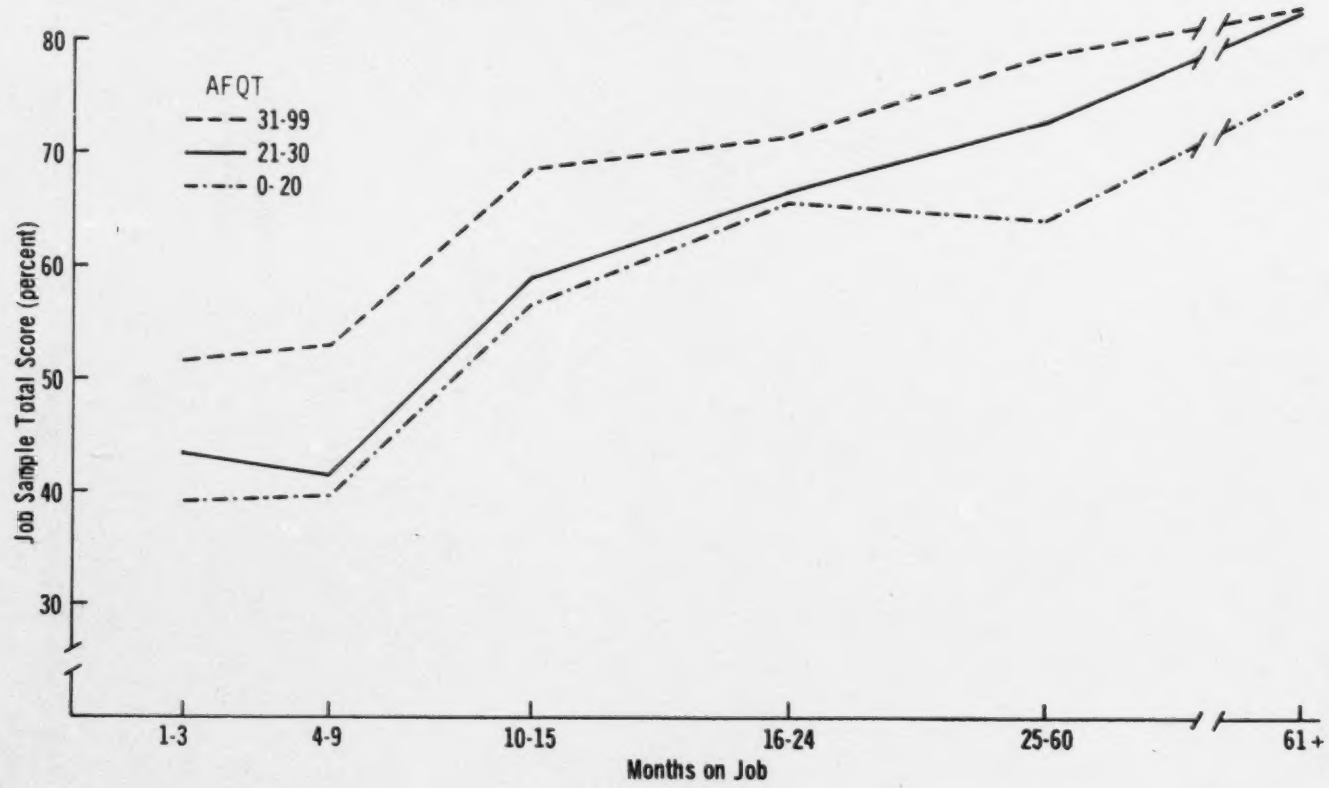


Figure 2.2

Repairman's Job Sample Score by Time on Job for AFQT Groups

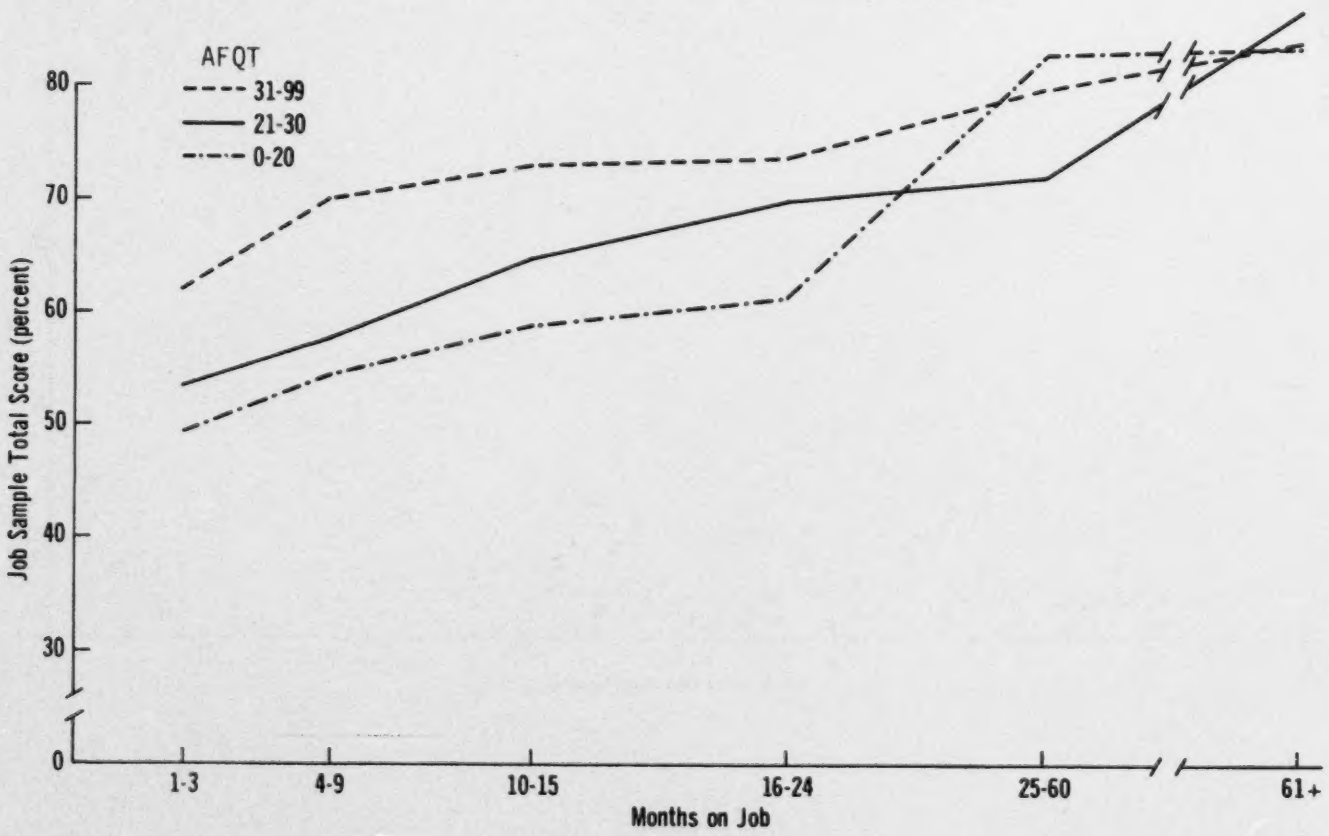


Figure 2.3

Supply Specialist's Job Sample Score by Time on Job for AFQT Groups

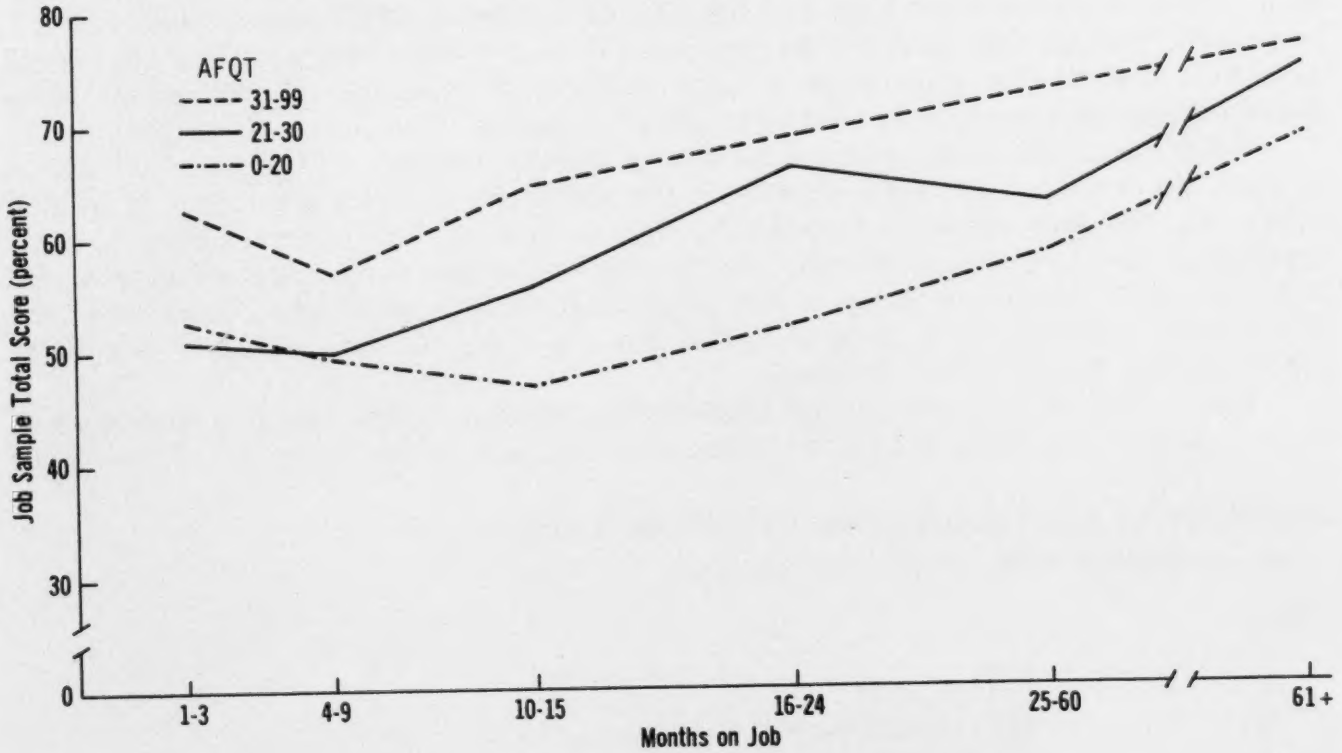


Figure 2.4

Cook's Job Sample Score by Time on Job for AFQT Groups

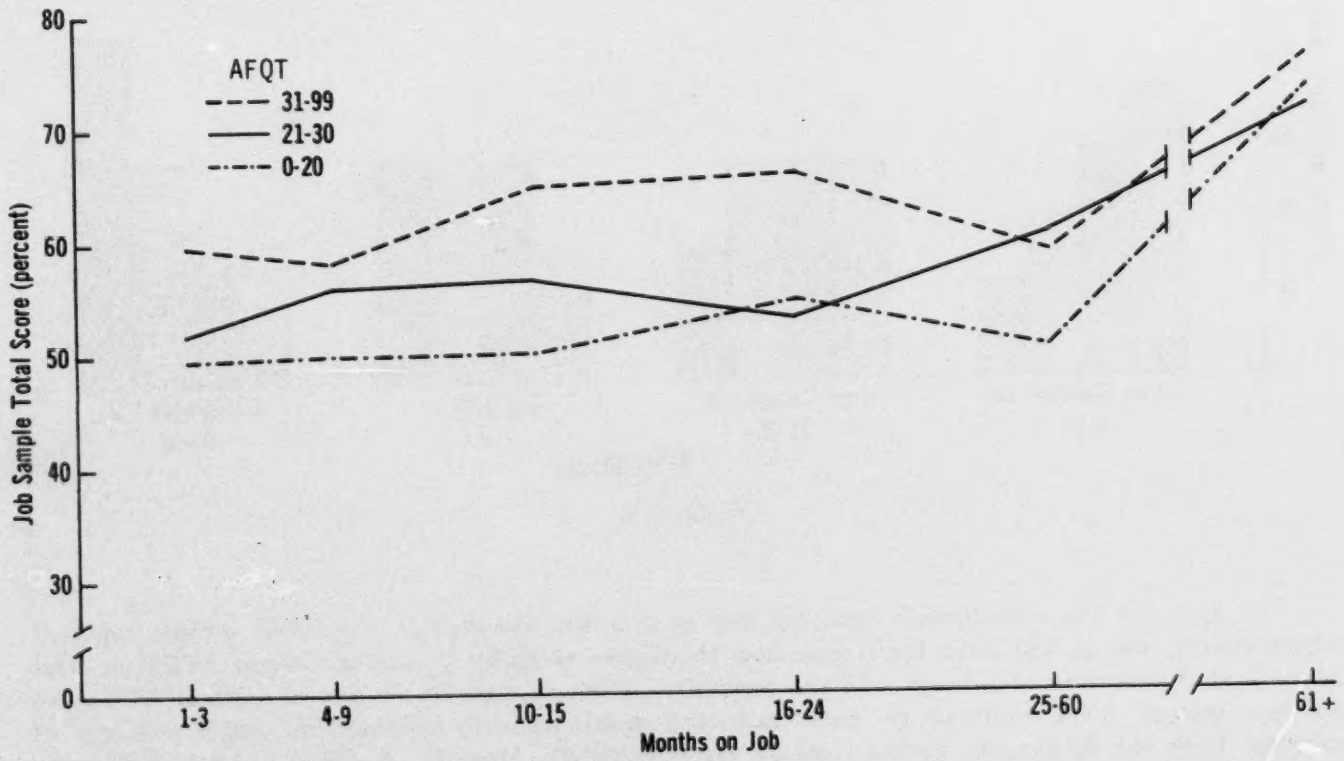


Figure 2.5

While the curves show some variation in rate of growth with different amounts of displacement between comparable groups from one MOS to another, the overall pattern is clear. Performance improves both as a function of increasing AFQT and increasing MOJ.[6] In general, through five years on the job, Non-IVs exceed High IVs, who, in turn, exceed Low IVs. Beyond five years there is some evidence of convergence, with points being closer together and positioning relative to AFQT being lost in at least two of the jobs.

While the graphs using means show clear separation between AFQT groupings out to at least five years, it has been obvious in the scatter plots that a great deal of overlap exists. An alternate method of presenting data is to group subjects aaccording to their position in the Job Sample distribution. In Figure 2.6 the percentages of men in the different AFQT groupings falling in the lowest, two middle, and highest quarters of the Job Sample distribution are presented. The figure is drawn for men with 1-18 months of job experience for all MOSs combined.

Figure 2.6 reflects the general relationship between AFQT and job performance. Thus it is seen that there is a greater probability that men at the lower end of the AFQT

Distribution of AFQT Groups With 1-18 Months-on-Job on Job Sample Tests *(Four MOSs Combined)*

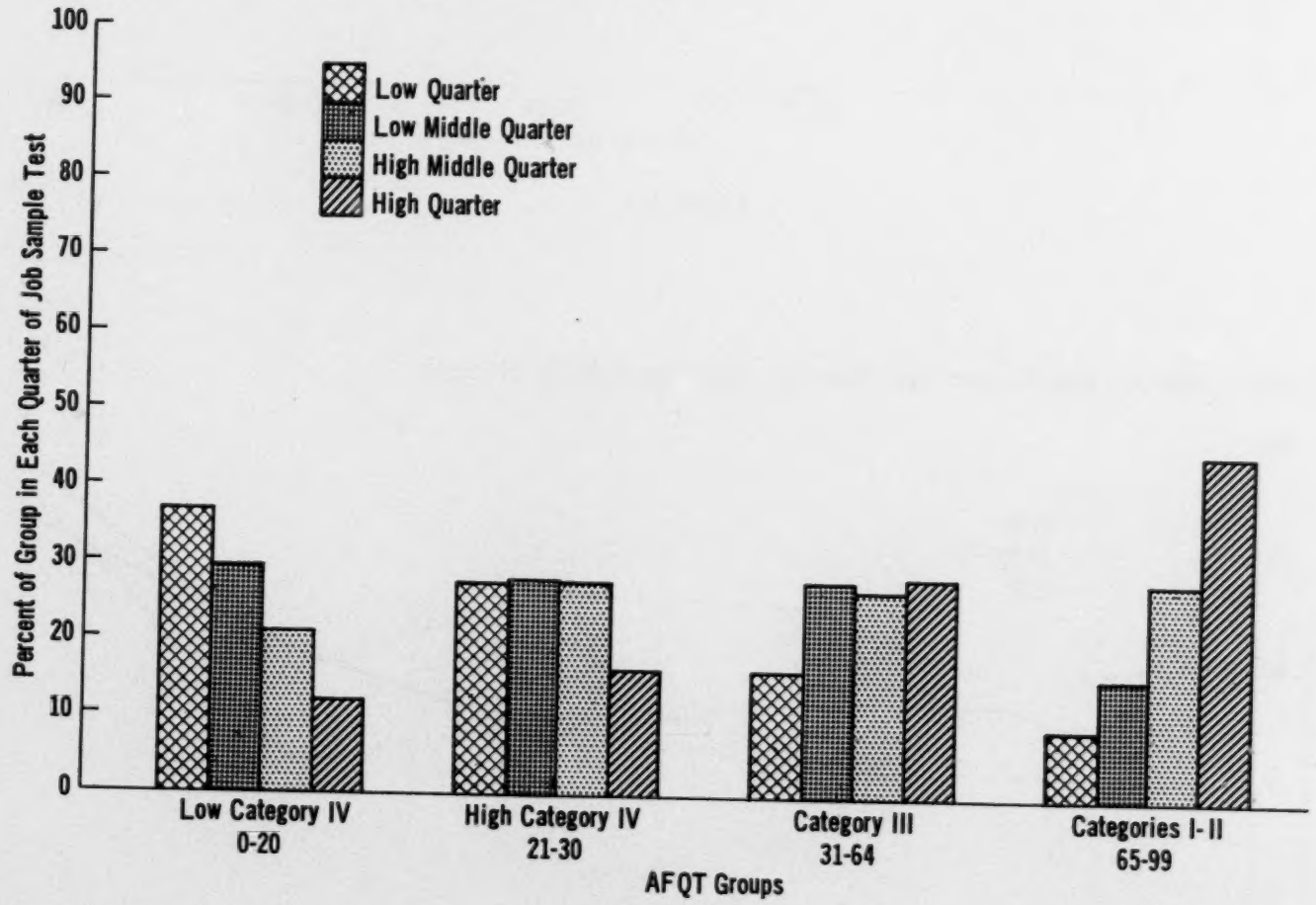


Figure 2.6

[6]In graphing the Job Sample data (as well as Job Knowledge and Supervisor ratings, reported subsequently), the groups have been organized to display as many points at various AFQT or time intervals as the number of subjects and the regularity of the data permit. Statistical tests of differences between groups, were confined to more restricted groupings with considerably larger numbers of subjects. Both the differences between AFQT levels (Low IV, High IV, Non-IV) and the differences between MOJ levels (1-9, 10-24, 25+) were found to be reliable.

distribution will perform in the lowest quarter. This is mirrored at the high end of the distribution where men are more likely to score in the highest quarter. However, the critical observation is that a substantial proportion of men at all AFQT levels falls into each quarter of the Job Sample distribution. For example, 33% of the 0—20 AFQT group score in the upper half of the distribution whereas 25% of the 65—99 AFQT group score in the lower half of the distribution. In the first 18 months the similarity of performance of the High Category IVs and Category IIIs is striking. A little less than half (44%) of the High Cat IV group scored above the median, whereas a little more than half (56%) of the Cat IIIs scored above the median (the latter group having been historically acceptable for service).

Men with between one and 18 months of job experience made up 67% of the UTILITY sample in the four MOSs reported. The Army in general is heavily weighted with men from this time segment—approximately the first two years of a first tour. Since, at any given time, most men working in an MOS fall within this first year and a half of job experience, performance in this time segment approximates modal performance in the Army. The data for men with longer job experience have been sorted into the quarters used for the 1—18 month group to compare their performance. Figures 2.7 and 2.8 display these data.

The implications to be drawn from these Figures are clear. With time, an increasing proportion of men at all AFQT levels appear in the upper ranges of the performance

Distribution of AFQT Groups With 19-30 Months-on-Job on Job Sample Tests

(Four MOSs Combined—in Relation to Quarters of 1-18 MOJ Subsample)

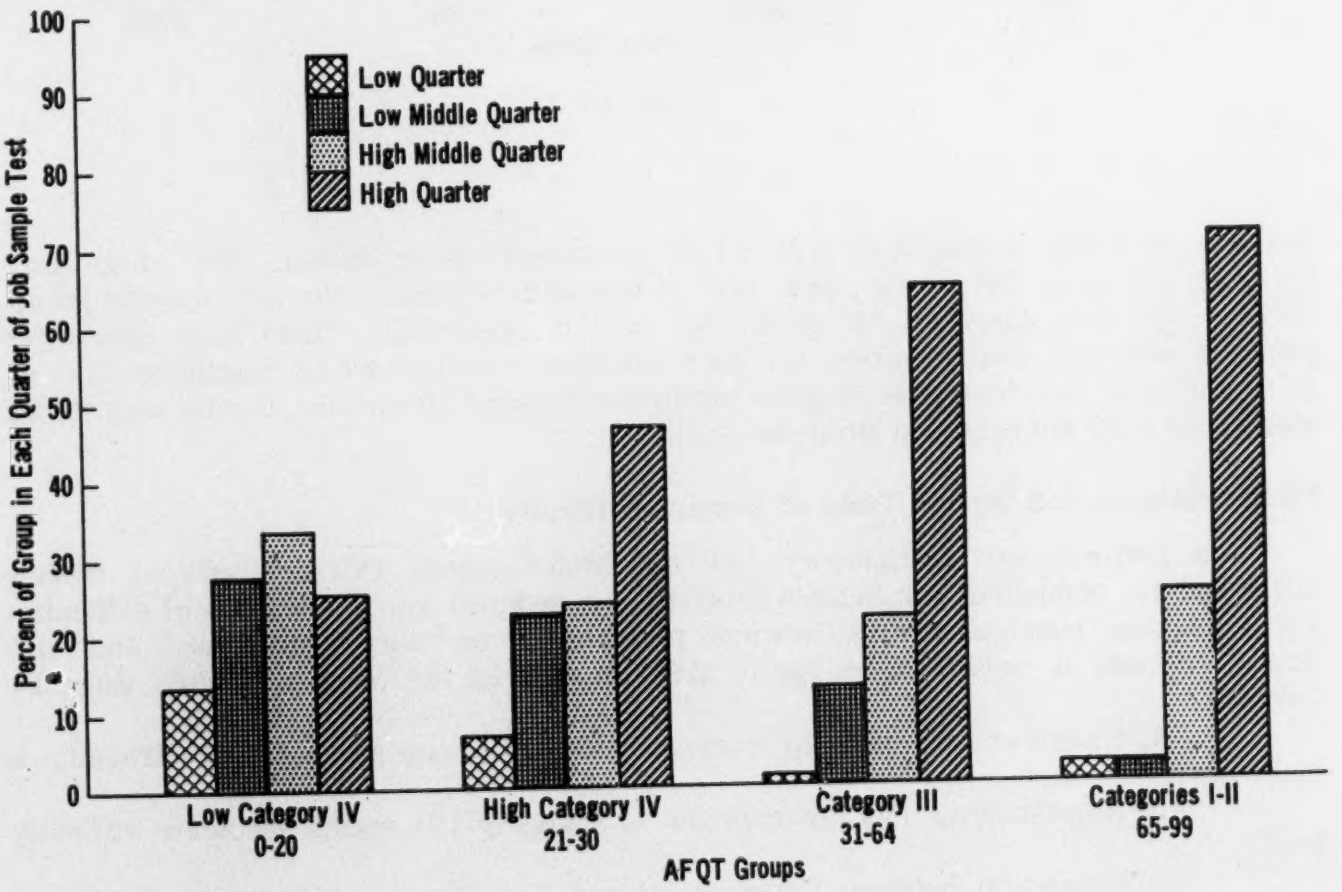


Figure 2.7

Distribution of AFQT Groups With 31+ Months-on-Job on Job Sample Tests

(Four MOSs Combined—in Relation to Quarters of 1-18 MOJ Subsample)

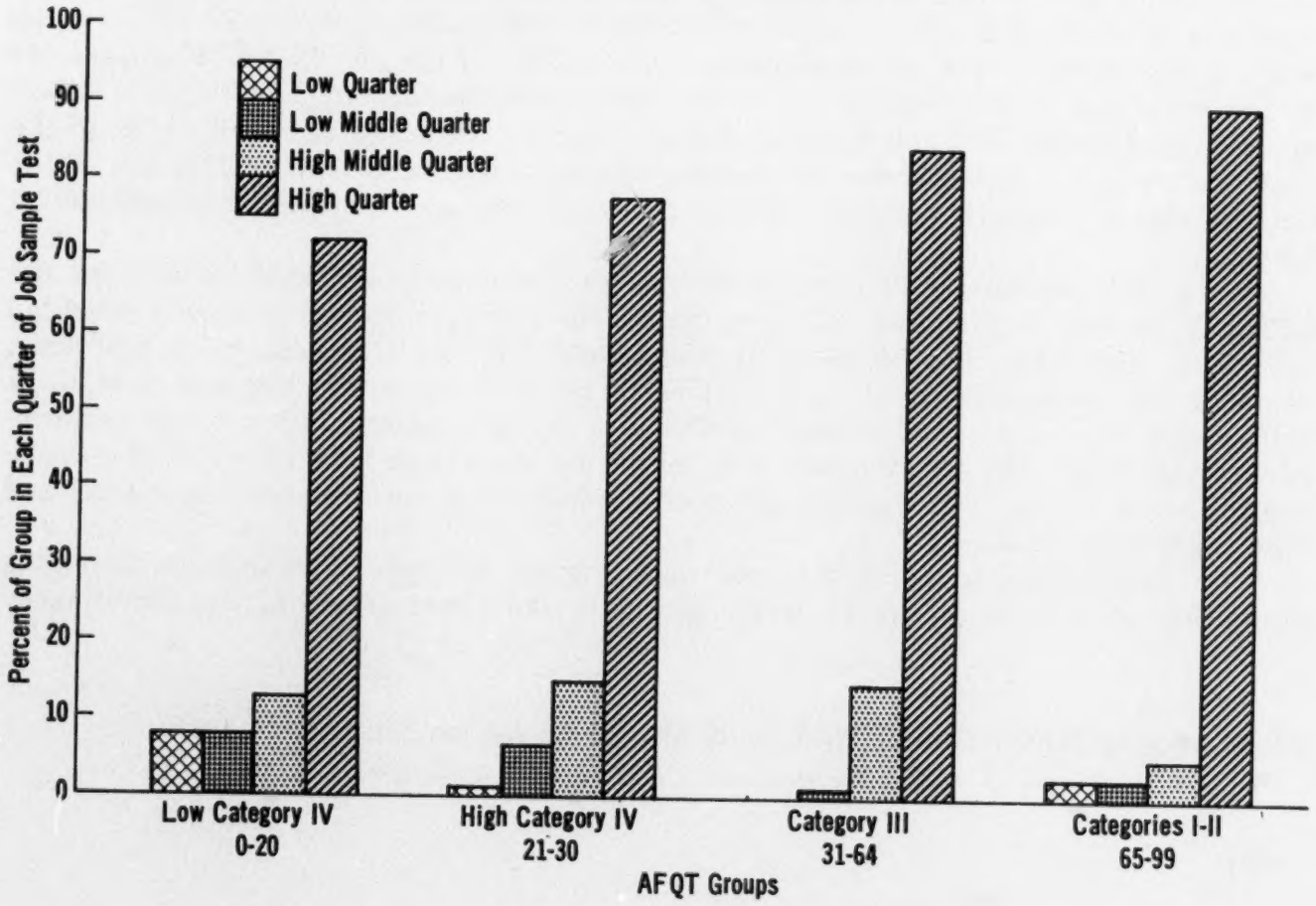


Figure 2.8

distribution. Thus, among men with 19-30 months-of-job experience, 59% of the Low Category IV group fall in the upper half of the distribution. In the 30+ months group, 85% of the Low Category IV group fall in this upper half. These data suggest the potential loss of a sizable number of good performers in the first 18 months on the job, as well as even larger numbers of good performers beyond 18 months, if men with AFQT scores below 20 are excluded from the service.

Performance on Job Sample Tasks of Varying Difficulty

The performance of Category IVs and Non-Category IVs on tasks of varying difficulty was compared. Job Sample subtests were grouped into three levels of difficulty. For illustrative purposes Armor Crewman performance on "easy," "medium," and "difficult" subtests is presented in Figure 2.9. In each of the MOSs, the data generally indicate:

(1) Separation of pairs of curves representing varying levels of difficulty is maintained over time.

(2) Non-Category IVs are superior to Category IVs within the same difficulty level.

(3) Separation between Category IV and Non-Category IV curves increases as tasks increase in difficulty.

Performance on Easy, Medium, and Difficult Tasks: Armor Crewman by AFQT and MOJ *(percent)*

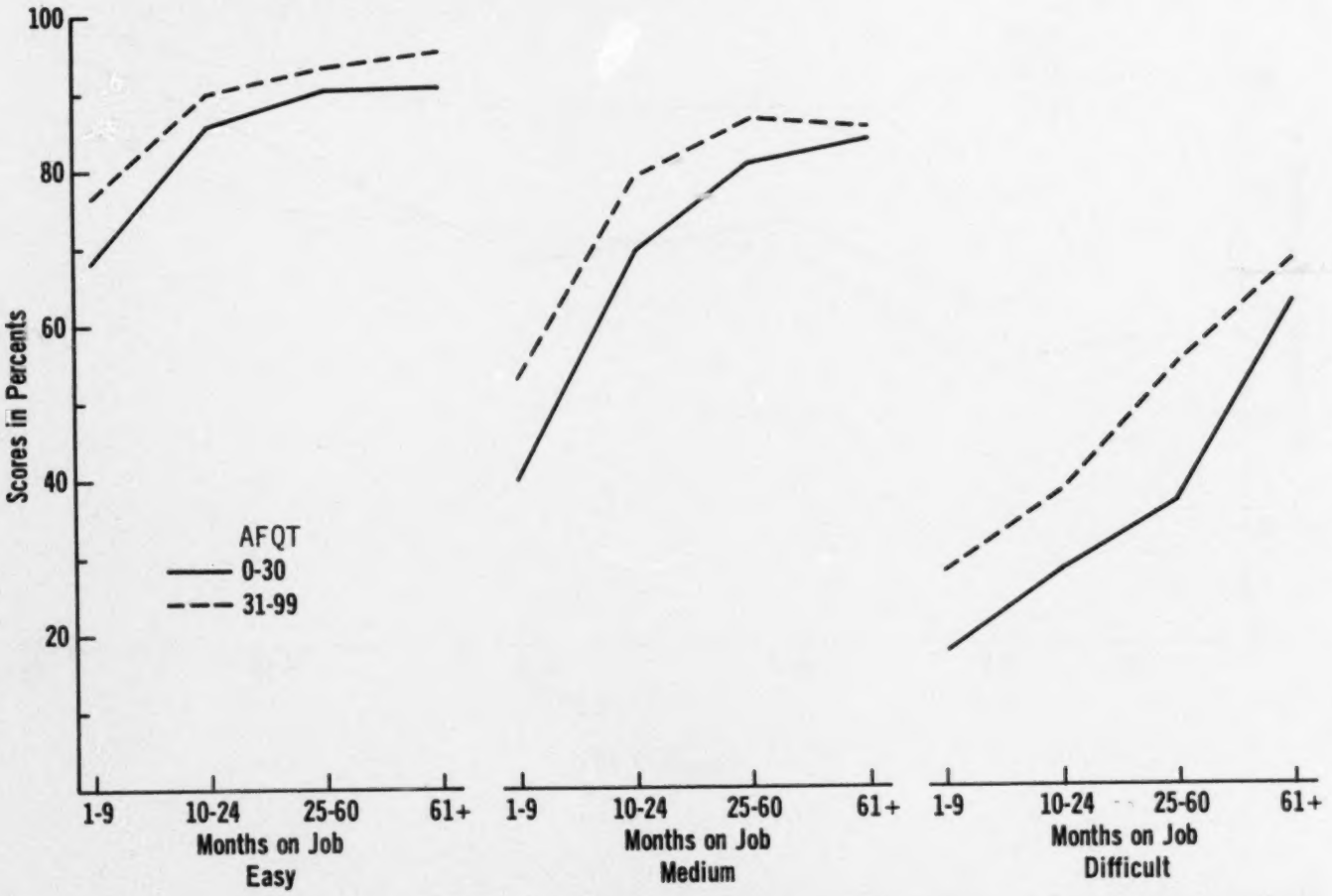


Figure 2.9

(4) Growth in performance occurs as a result of experience at each level of difficulty. The least change is seen in "easy" tasks where performance is at a fairly high level almost immediately upon entry into the job.[7]

Although the size of differences between AFQT or job experience groupings obviously depends on the particular intervals selected for comparison, larger differences appear across the job experience dimension than across the AFQT dimension.

Performance on Job Knowledge Tests

Scatter plots of individual Job Knowledge scores were found to be generally similar to scatter plots of Job Sample scores. Like the Job Sample tests, performance on Job Knowledge tests was quite variable during the first 30 months of job experience. With additional experience there was a progressive diminution of the lower scores with a resultant decrease in variability and a higher mean performance. The overlap between the Category IV and Non-Category IV distributions was again considerable. Mean Job Knowledge scores for three AFQT levels and six MOJ levels are given in Figures 2.10—2.13.

The relationship of Job Knowledge scores to AFQT and MOJ is much the same as that observed with the Job Sample data. Performance improves both as a function of

[7] Differences attributable to AFQT and MOJ on tasks of varying difficulty were reliable in all instances except for comparisons of AFQT groups among Cooks on the "easy" task.

Armor Crewman's Job Knowledge Score by Time on Job for AFQT Groups

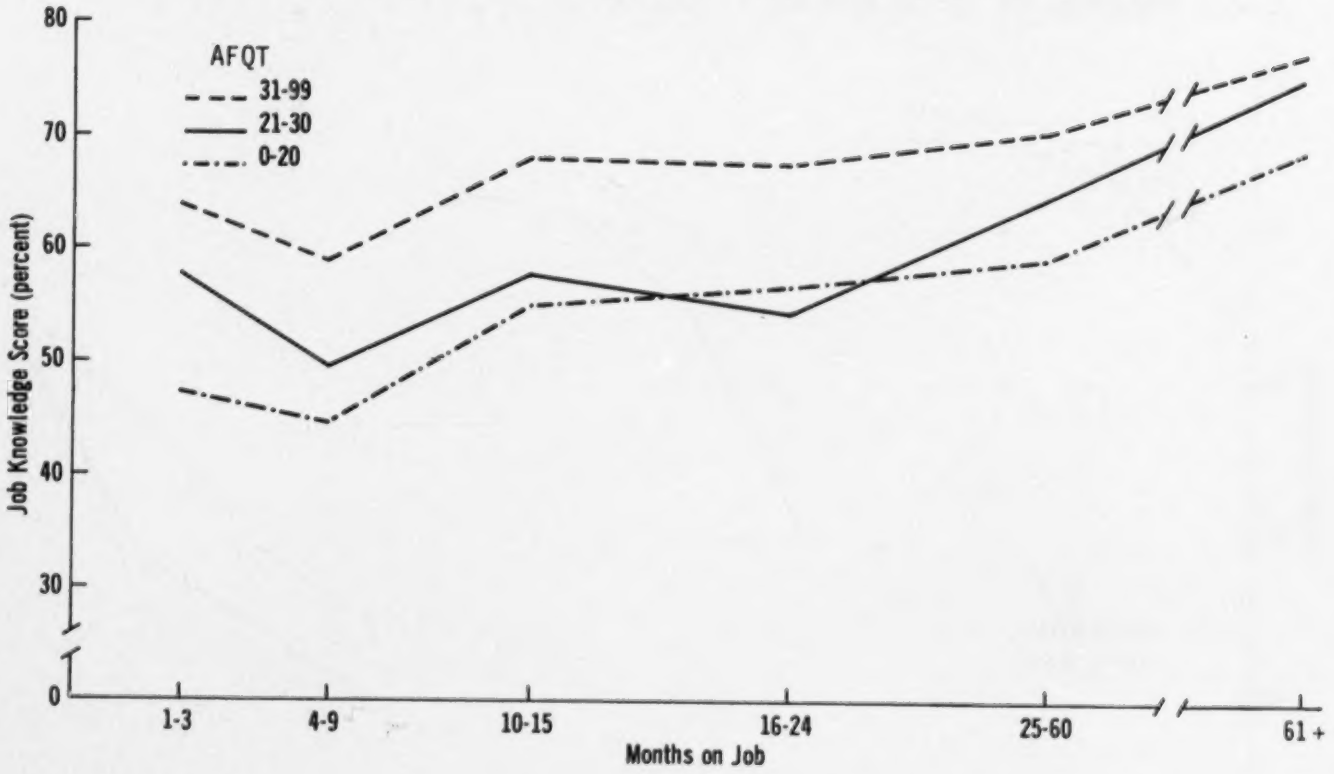


Figure 2.10

Repairman's Job Knowledge Score by Time on Job for AFQT Groups

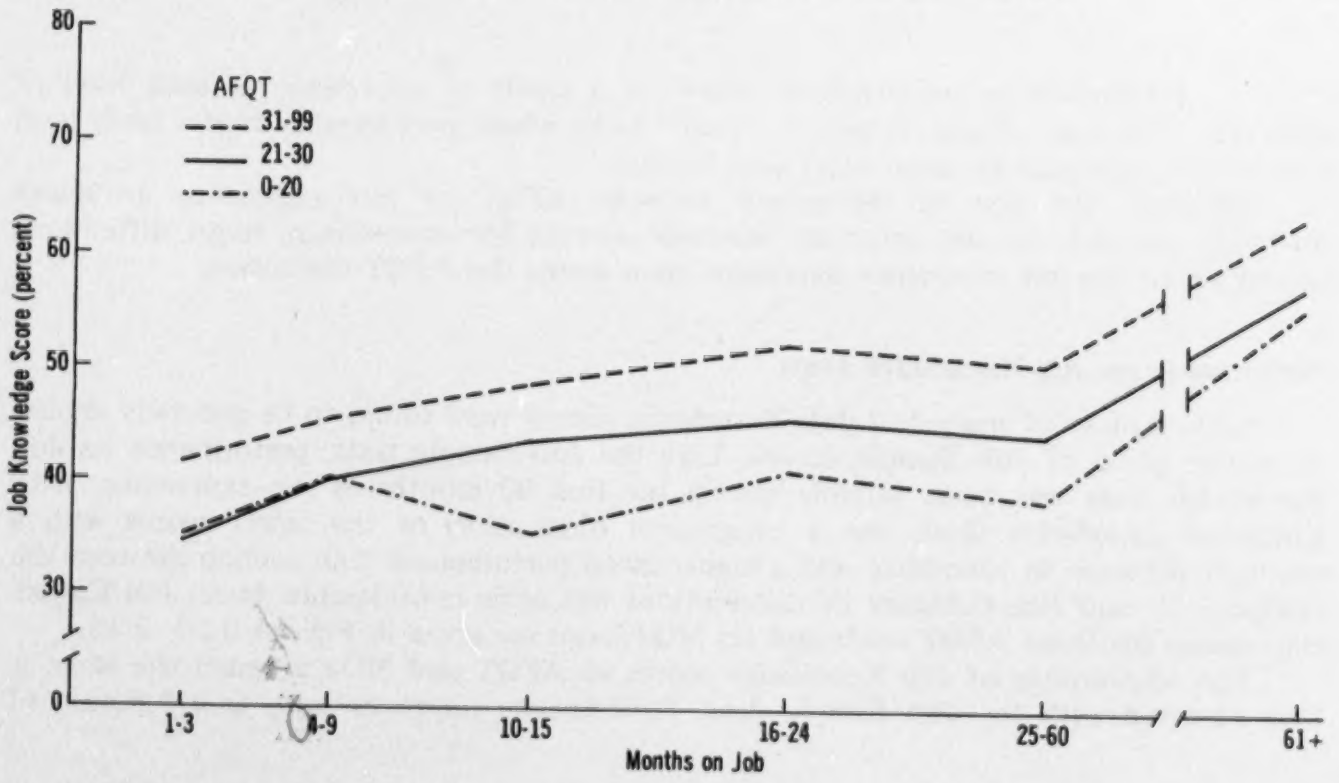


Figure 2.11

Supply Specialist's Job Knowledge Score by Time on Job for AFQT Groups

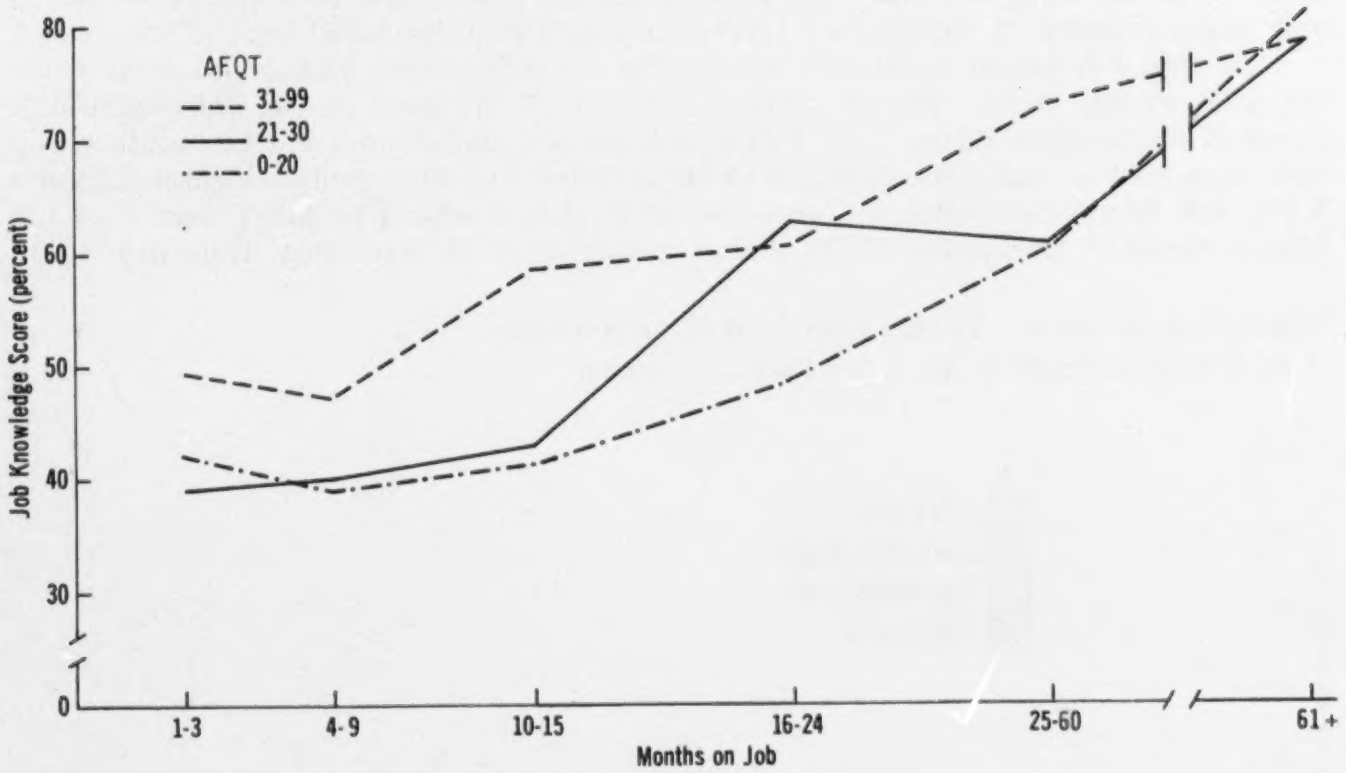


Figure 2.12

Cook's Job Knowledge Score by Time on Job for AFQT Groups

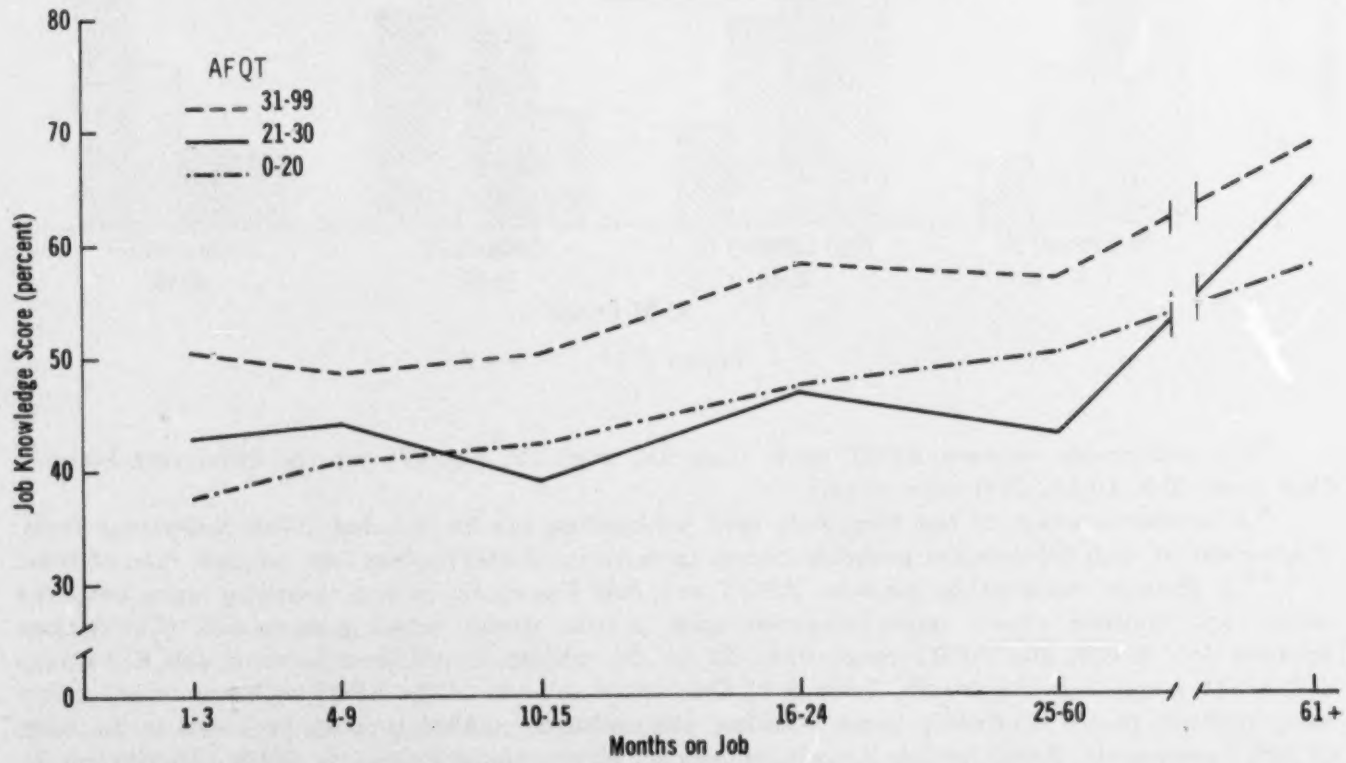


Figure 2.13

increasing AFQT and increasing MOJ.[8] For AFQT groups there is some overlap at scattered points along the time dimension. Unlike the Job Sample tests, however, there is only slight evidence of convergence (except in the Supply Specialist) beyond five years.[9]

As with Job Sample scores, Job Knowledge scores have been sorted into quarters for the 1-18 month group. The distribution for each AFQT level of the Job Knowledge scores is displayed in Figure 2.14. The distributions obtained on the 1-18 month group have been used to sort subjects in the 19-20 MOJ and 31+ MOJ groups (Figures 2.15 and 2.16). Job Knowledge scores are somewhat more closely related to AFQT than were Job Sample scores.[10] Over time, AFQT groups remain more differentiated. Thus, beyond 30

Distribution of AFQT Groups With 1-18 Months-on-Job on Job Knowledge Tests *(Four MOSs Combined)*

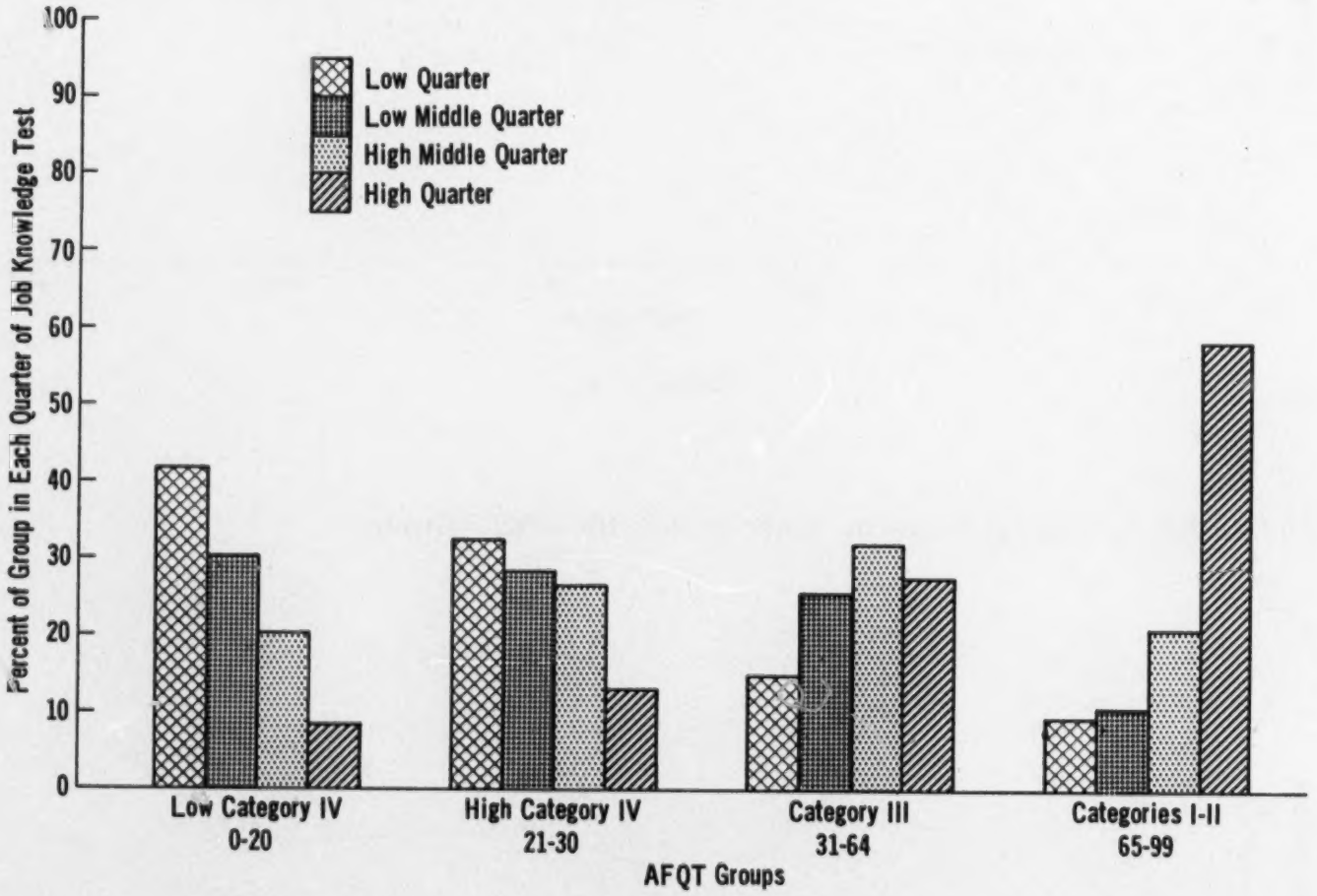


Figure 2.14

[8]The differences between AFQT levels (Low IV, High IV, Non-IV) and the differences between MOJ levels (0-9, 10-24, 25+) were reliable.

[9]A broader coverage of less frequently used information can be included in Job Knowledge Tests. Acquisition of such information probably occurs in more incidental manner over a longer span of time.

[10]A stronger relationship between AFQT and Job Knowledge is not surprising since both the AFQT and multiple choice paper-and-pencil tests possess strong verbal components. (Correlations between Job Sample and AFQT range from .27 to .35, whereas correlations between Job Knowledge and AFQT range from .29 to .46, Table 2.2.) One of the subtests of the AFQT measures verbal ability using multiple choice vocabulary items. Another, the arithmetic subtest, presents problems in the form of verbal statements. Scores on Job Knowledge tests are highly related to reading ability (See Chapter 3). Thus, AFQT and Job Knowledge scores are dependent upon a man's language skills and at least a moderate correlation between them is inevitable.

Distribution of AFQT Groups With 19-30 Months-on-Job on Job Knowledge Tests

(Four MOSs Combined—in Relation to Quarters of 1-18 MOJ Subsample)

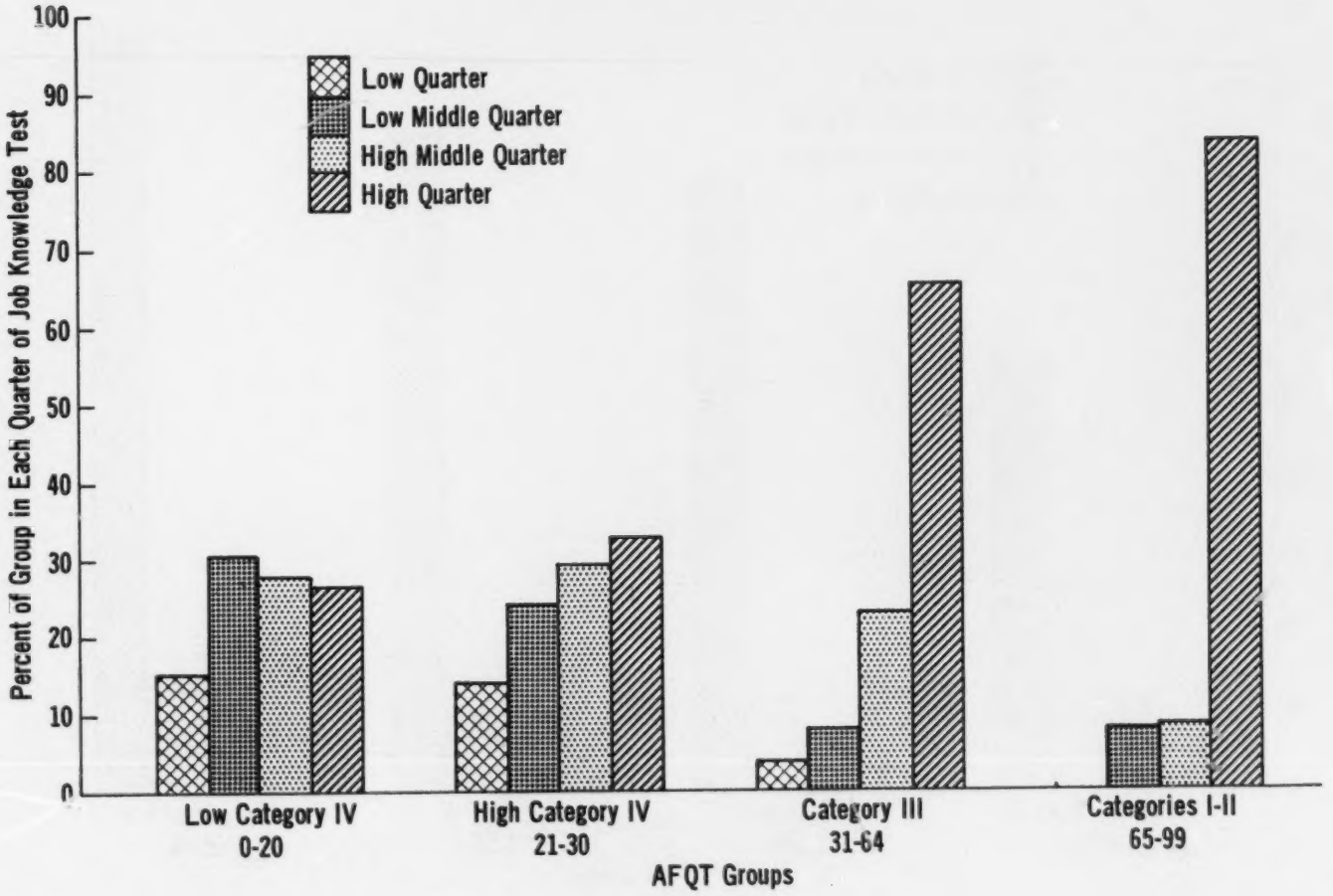


Figure 2.15

months on the job all men in Category I-II fall above the upper Job Knowledge quarter. Nevertheless, there is substantial representation of even the lowest AFQT group in the upper half of the distribution at each time interval. During the first 18 months, 29% of the 0-20 AFQT group fall in the upper half of the distribution; between 19 and 30 MOJ, 55% of this group fall in the upper half; and beyond 30 MOJ, this figure rises to 82%.

Supervisor Evaluations

The rating scales of the Commander's Evaluation Report (CER), used operationally throughout the Army, were administered as the rating instrument of this study. Supervisor Ratings for three AFQT levels and six MOJ levels are given in Figures 2.17—2.20.

The Supervisor Ratings are highly skewed with ratings tending toward the favorable end of the scale regardless of AFQT or MOJ level. Also, the means show a less orderly pattern than either Job Sample or Job Knowledge means. The variability obscures any clear differences between AFQT levels. There is some evidence however, for ratings to increase with job experience beyond two years.[11]

[11] Reliable differences attributable to AFQT were found in only two of the four MOSs. In these two MOSs, Repairman and Cook, Non-IVs were distinguished from both Low IVs and High IVs. Reliable differences attributable to MOJ were found only between groups with less and more than two years of job experience.

Distribution of AFQT Groups With 31+ Months-on-Job on Job Knowledge Tests

(Four MOSs Combined—in Relation to Quarters of 1-18 MOJ Subsample)

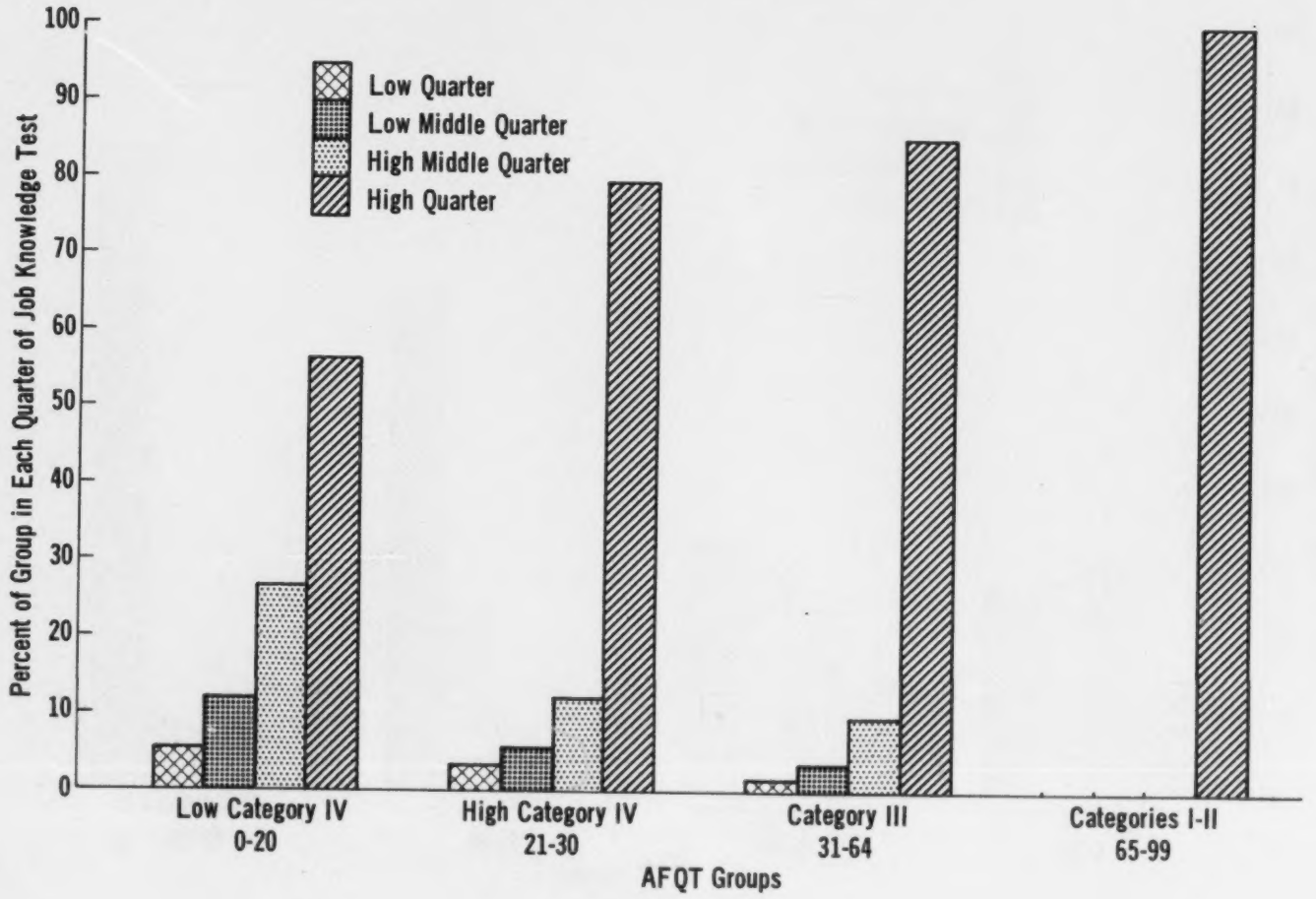


Figure 2.16

The inconsistent and relatively poor discrimination provided by the CER scales was not entirely unexpected. Summary rating instruments typically suffer from a variety of shortcomings: (1) They are dependent on the extent to which the rater has observed the ratee performing his job and upon his willingness to rate him; the ratings are frequently based upon casual and unsystematic observation; (2) They are highly subjective and susceptible to biasing by irrelevant factors such as the ratee's general manner and likableness; (3) They are influenced by halo effects, forgetting, and selective recall; and (4) Because they generally provide descriptions of behavior in global terms by summarizing performance over a whole period of work, rather than by evaluating specific acts, they tend to obscure differences in technical proficiency.

Armor Crewman's Supervisor Questionnaire by Time on Job for AFQT Groups

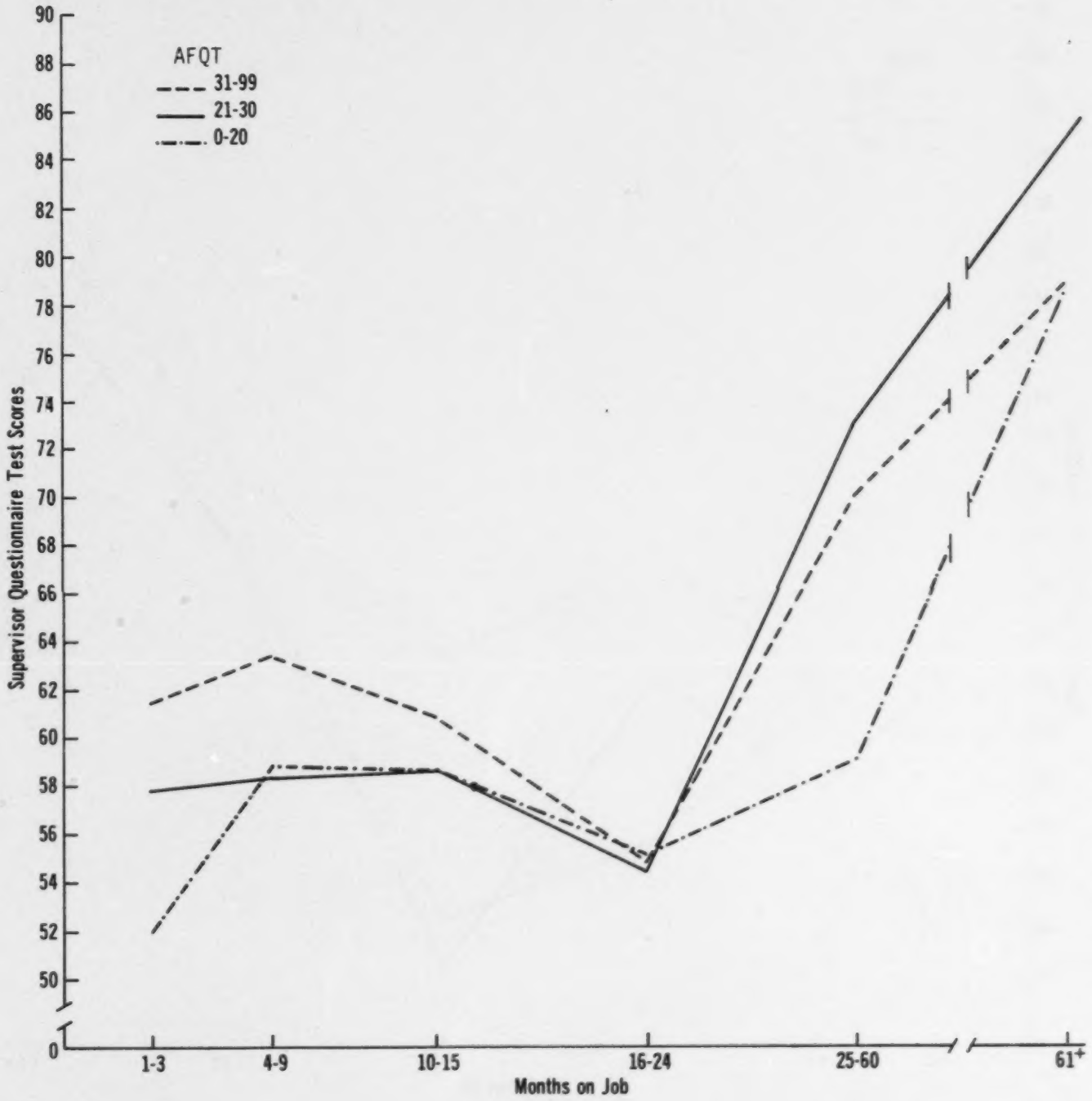


Figure 2.17

Repairman's Supervisor Questionnaire by Time on Job for AFQT Groups

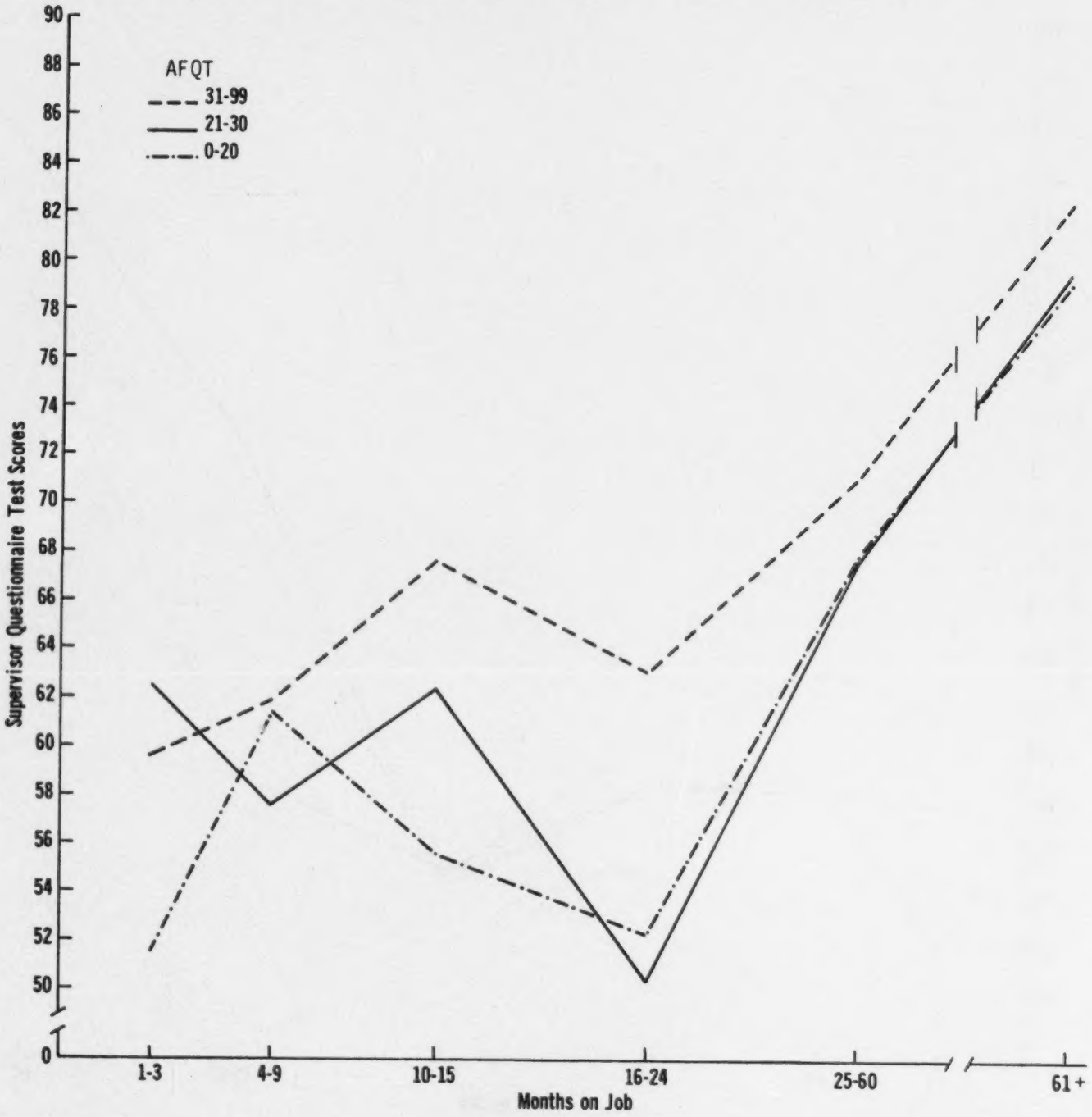


Figure 2.18

Supply Specialist's Supervisor Questionnaire by Time on Job for AFQT Groups

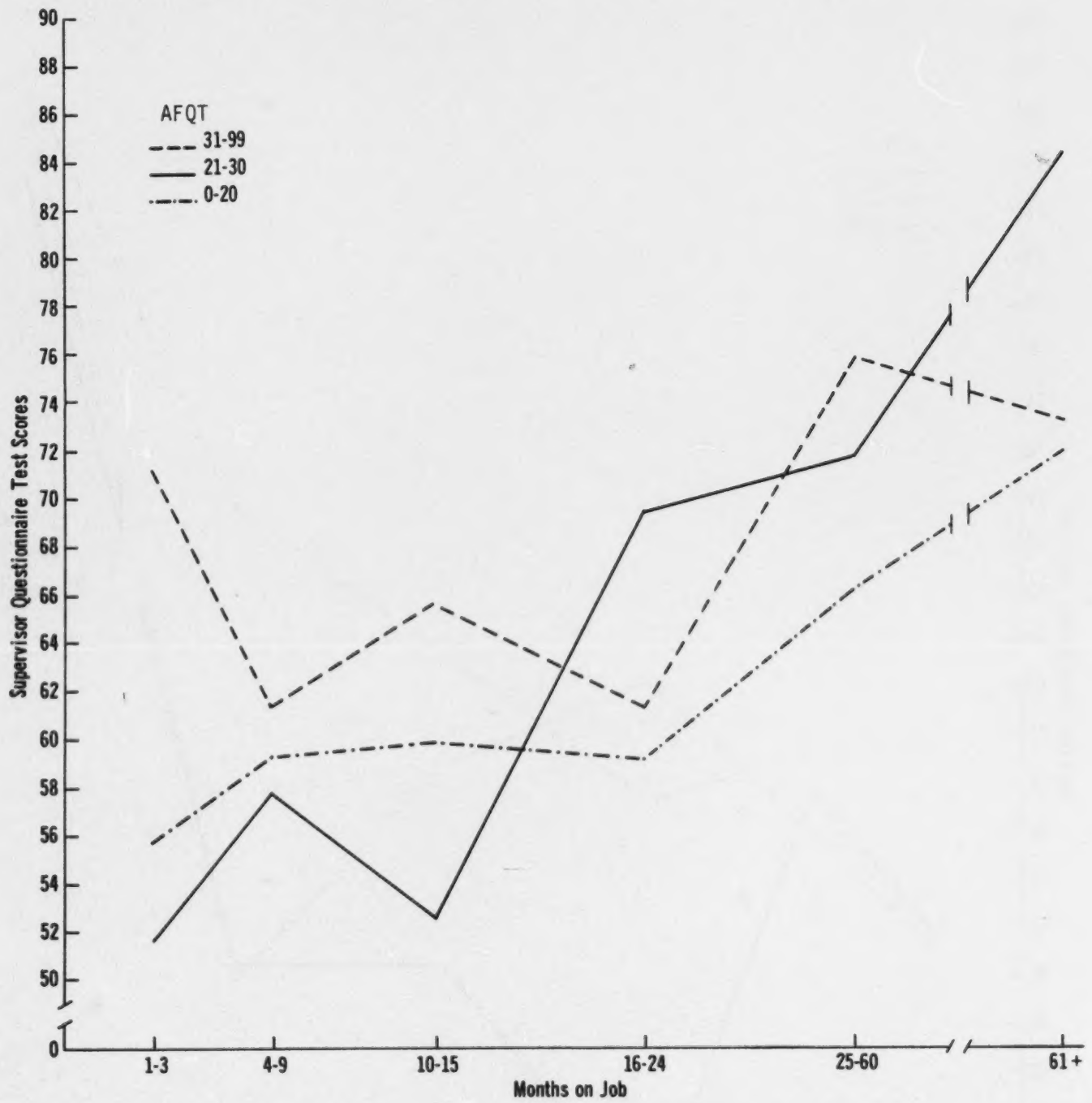


Figure 2.19

Cook's Supervisor Questionnaire by Time on Job for AFQT Groups

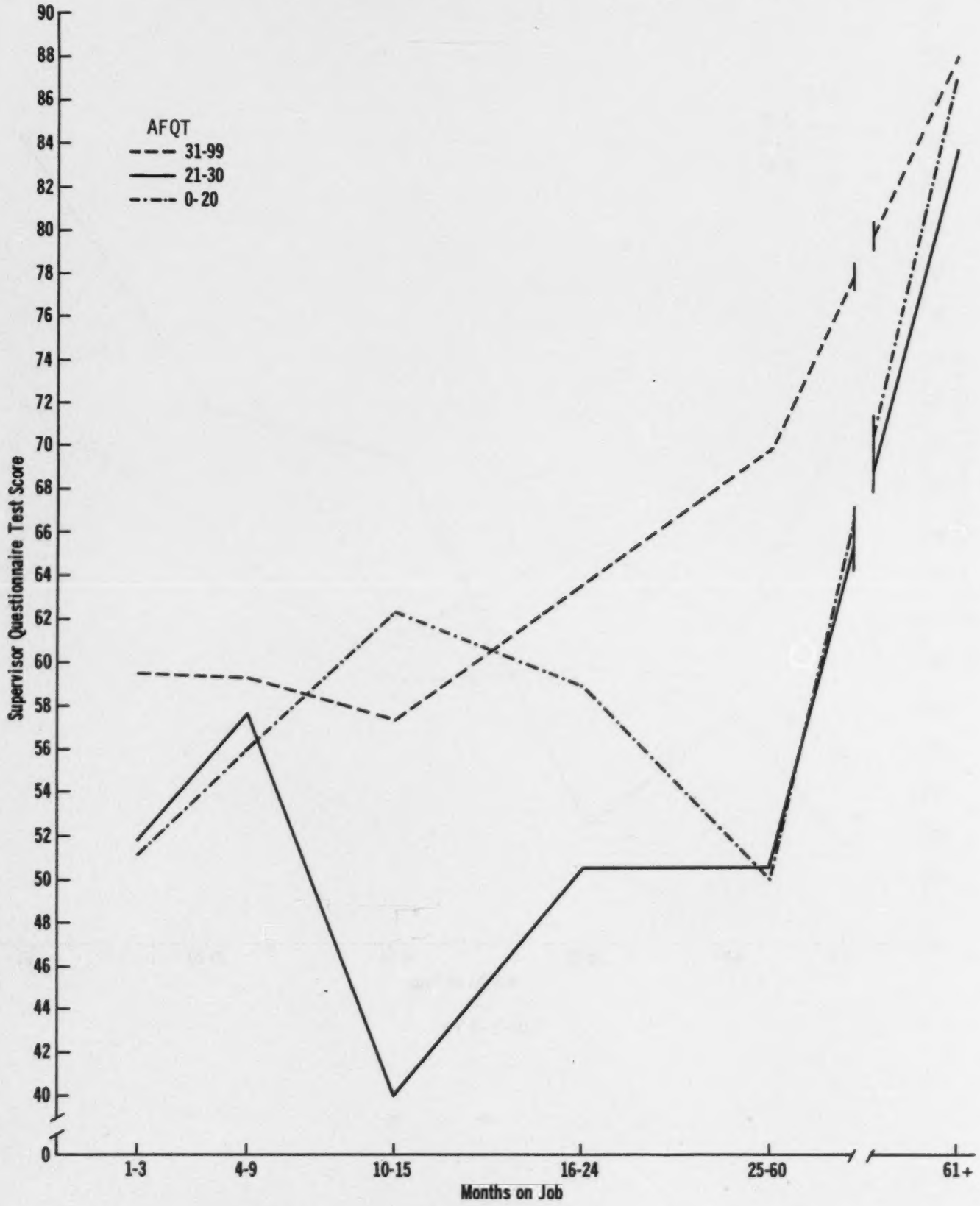


Figure 2.20

Relationships of AFQT and MOJ With Job Sample and Job Knowledge Scores

The correlations of AFQT and MOJ with Job Sample and Job Knowledge test scores were compared. AFQT proved to be more poorly related to either the Job Sample or the Job Knowledge criterion of performance than job experience (Tables 2.2 and 2.3). For the entire sample, partial correlations of AFQT with Job Sample tests ranged from .32 to .38, and with Job Knowledge tests from .37 to .54. Partial correlations of MOJ with Job Sample tests ranged from .40 to .71, and with Job Knowledge tests from .48 to .66. For the restricted range of Category IV subjects, partial correlations of AFQT with Job Sample tests ranged from .10 to .21, and with Job Knowledge tests from .08 to .26. Only two of these latter eight partial correlations are reliably different from zero. Partial correlations of MOJ with Job Sample tests for the Category IV sample ranged from .41 to .72, and with Job Knowledge tests from .44 to .67.

For either predictor (AFQT or MOJ), job information is generally more accurately estimated than job sample performance. The greater predictability of job information is at least partly attributable to the greater simplicity of this variable. While the job knowledge score is relatively unitary in nature, job performance is a product of the interaction of a variety of factors including job skill and job information itself.

In summary, the general pattern of relationships from highest to lowest across the four MOSs was:

(1) MOJ and Job Knowledge score
(2) MOJ and Job Sample score
(3) AFQT and Job Knowledge score
(4) AFQT and Job Sample score

Thus it is seen that the strongest relationship exists between the amount of experience a man has and the amount of information he possesses about his job. The weakest relationship exists between a man's AFQT score and his performance of that job.

Table 2.2

Correlations of AFQT and MOJ With Job Sample and Job Knowledge Test Scores[a]

	Armed Forces Qualification Test		Months on Job	
	Job Sample	Job Knowledge	Job Sample	Job Knowledge
	Zero-Order Correlations			
Armor Crewman	.27	.46	.69	.55
Repairman	.30	.39	.43	.45
Supply Specialist	.35	.29	.43	.63
Cook	.33	.43	.39	.46
	Partial Correlations[b]			
Armor Crewman	.36	.54	.71	.61
Repairman	.32	.42	.44	.48
Supply Specialist	.38	.37	.46	.66
Cook	.35	.47	.40	.50

[a]All correlations are significantly different from zero ($p < .05$).
[b]Partial correlations between AFQT and the criteria with MOJ partialled out; MOJ correlations are with AFQT partialled out.

Table 2.3

Correlations for Category IV and Non-Category IV Subgroups of AFQT and MOJ With Job Sample and Job Knowledge Test Scores[a]

	Armed Forces Qualification Test				Months on Job			
	Job Sample		Job Knowledge		Job Sample		Job Knowledge	
	Cat. IV	Non-IV	Cat. IV	Non-IV	Cat. IV	Non-IV	Cat. IV	Non-IV
	Zero-Order Correlations							
Armor Crewman	.25*	.16*	.35*	.33*	.73*	.68*	.64*	.55*
Repairman	.21*	.21*	.18*	.28*	.48*	.37*	.46*	.49*
Supply Specialist	.25*	.20*	.15*	.21*	.46*	.44*	.68*	.62*
Cook	.15	.20*	.19*	.38*	.42*	.37*	.50*	.44*
	Partial Correlations[b]							
Armor Crewman	.11	.27*	.26*	.43*	.72*	.70*	.61*	.59*
Repairman	.12	.23*	.10	.33*	.46*	.38*	.44*	.51*
Supply Specialist	.21*	.25*	.08	.31*	.44*	.46*	.67*	.65*
Cook	.10	.20*	.13	.40*	.41*	.37*	.49*	.46*

[a]Asterisks denote correlations that are significantly different from zero ($p < .05$).

[b]Partial correlations between AFQT and the criteria with MOJ partialled out; MOJ correlations are with AFQT partialled out.

Relationships Between Personal Characteristics and Job Sample and Job Knowledge Scores

A total of 124 background and personal characteristics were examined in an attempt to identify characteristics that might be predictive of successful performance in the Category IV and Non-IV subsamples.

In addition to aptitude and aptitude area scores taken from a man's records, the study included a variety of measures such as a nonverbal test of intelligence, tests of carefulness and the ability to comprehend and follow oral directions, tests of memory for detail and digit span, tests of reading, arithmetic, and listening comprehension, and a checklist designed to measure a man's exposure to common middle class experiences (akin to socioeconomic study).[12] A biographical questionnaire provided demographic data about a man's family, education, and premilitary history. Information was obtained about family cohesion, family mobility, and parental interest during a man's formative years. Also, information such as work habits, experiences showing delinquent behavior, and conflict with authority was obtained.

Of the 124 variables analyzed only one predictor, Listening Test Score,[13] was correlated appreciably with both Job Sample and Job Knowledge test scores. The correlations of Listening Test with Job Sample and Job Knowledge scores are presented in Table 2.4 for the entire sample and for the Category IV and Non-IV subsamples. For comparison, correlations of AFQT with the criteria are also given.

[12]It would have been desirable to include in the test battery specific measures of a man's motivation to perform in his job. None was included since it was not possible to identify instruments of sufficient promise of validity as measures of motivation.

[13]Developed as part of Work Unit REALISTIC. (See Chapter 3 for description).

Table 2.4

Partial Correlations of Listening Test and AFQT Scores With Job Sample and Job Knowledge[a]

	Total Sample		Category IVs		Non-Category IVs	
	Listening	AFQT	Listening	AFQT	Listening	AFQT
			Job Sample			
Armor Crewman	.29*	.36*	.10	.11	.29*	.27*
Repairman	.38*	.32*	.36*	.12	.20*	.23*
Supply Specialist	.42*	.38*	.28*	.21*	.36*	.25*
Cook	.28*	.35*	.24*	.10	.22*	.20*
			Job Knowledge			
Armor Crewman	.53*	.54*	.38*	.26*	.46*	.43*
Repairman	.40*	.42*	.31*	.10	.28*	.33*
Supply Specialist	.35*	.37*	.27*	.08	.22*	.31*
Cook	.39*	.47*	.31*	.13	.38*	.40*

[a]Correlations have been computed with the effects of MOJ partialled out. Correlations significantly different from zero are marked with an asterisk.

The correlations of Listening Test score with each criterion for the entire sample are quite similar to those between AFQT and the criteria. However, when relationships are examined for Category IVs separately, the correlations between Listening Test score and the criteria are found to be somewhat higher than for AFQT. The lower relationship with AFQT may reflect the restriction of AFQT to scores 0-30.

The Listening Test was designed to assess a man's comprehension and short term recall of orally presented material. While it was included in the test battery as one of the measures of literacy skills, a man's score on the Listening Test is also dependent upon his ability to maintain attention to, and remember, orally presented information, which is transient (unlike most reading or cognitive tests) and which occurs at a rate of presentation not under control of the listener. In addition to these attention and forced-pace factors, the Listening Test shares with AFQT a fair component of general language ability as indicated by the correlation between these variables and reading (Chapter 3).

For the full range of AFQT, the correlation of Listening with Job Sample provides no better prediction of performance than AFQT, and when AFQT and Listening are used in combination to predict Job Sample (Multiple Correlation), the gain in prediction is very small. However, the fact that listening test scores are more highly related than AFQT to Job Sample scores for the restricted AFQT range of Category IV men suggests that the listening test might be useful as an additional screening test for administration to Category IV men. This might permit further differentiation of successful and unsuccessful performers within the Mental Category IV group of men.

Several other predictors were found to be correlated with Job Knowledge score but not Job Sample score. The correlations of these variables with Job Knowldge score are given in Table 2.5. While most of the correlations given in this table are fairly substantial, none of the relationships of these same variables with Job Sample shows sufficient strength and consistency across MOSs to be of any further interest.

Table 2.5

Partial Correlations of Additional Variables Related to Job Knowledge for Category IV and Non-Category IV Subsamples[a]

	Army Classification Battery		Aptitude Areas			Reading Grade Placement
	General Information	Mechanical Aptitude	Armor, Artillery, Engineer, Combat	Electronics	Motor Maintenance	
Armor Crewman						
Category IV	.24*	.39*	.24*	.31*	.29*	.34*
Non-IV	.31*	.33*	.38*	.38*	.29*	.49*
Repairman						
Category IV	.27*	.31*	.37*	.28*	.35*	.31*
Non-IV	.21*	.42*	.39*	.48*	.37*	.37*
Supply Specialist						
Category IV	.26*	−.03	.26*	.11	.05	.18*
Non-IV	.16*	.22*	.24*	.35*	.22*	.34*
Cook						
Category IV	.35*	.26*	.35*	.24*	.24*	.51*
Non-IV	.36*	.41*	.44*	.35*	.43*	.43*

[a]Asterisks denote correlations that are significantly different from zero.

Interrelationships Among Criterion Measures

The intercorrelations among the criterion instruments used in the study indicate a high degree of relationship between Job Sample and Job Knowledge test scores, but a considerably lower degree of relationship between either of these criteria and Supervisor Ratings (Table 2.6).

Table 2.6

Correlations of Job Sample, Job Knowledge, and Supervisor Ratings for the Entire Sample[a]

	Armor Crewman	Repairman	Supply Specialist	Cook
	Zero-Order Correlations			
Job Sample-Job Knowledge	.68	.59	.72	.58
Job Sample-Supervisor Ratings	.27	.20	.28	.28
Job Knowledge-Supervisor Ratings	.31	.23	.32	.35
	Partial Correlations[b]			
Job Sample-Job Knowledge	.49	.49	.65	.50
Job Sample Supervisor Ratings	.13	.16	.24	.20
Job Knowledge-Supervisor Ratings	.21	.18	.29	.27

[a]All correlations are significantly different from zero ($p < .05$).
[b]Correlations with the effects of MOJ partialled out.

The information a man has about a job, which is measured directly by Job Knowledge tests, is also a major determinant of his performance on Job Sample tests. This common element of job proficiency undoubtedly underlies the strong relationship between these two criteria.

The Supervisor Rating (Commander's Evaluation Report) used in the study, attempts to measure a man's more general characteristics such as his cooperativeness and reliability. Only two of its 14 scales deal directly with job performance or job knowledge. The low correlations of the Supervisor Rating with Job Sample and Job Knowledge are understandable in that the rating scales are intended to measure more global aspects of behavior.

The substantial correlations obtained in each MOS between Job Sample and Job Knowledge scores are examined for the Category IV and Non-Category IV groups individually in Table 2.7. Of particular importance: for the restricted Category IV and Non-Category IV groups separately, the correlations remain highly similar to those of the entire sample (Table 2.6).

Table 2.7

Correlations of Job Sample and Job Knowledge for Category IV and Non-Category IV Subgroups[a]

	Armor Crewman	Repairman	Supply Specialist	Cook
		Zero-Order Correlations		
Category IV	.66	.59	.69	.54
Non-Category IV	.66	.54	.72	.54
		Partial Correlations[b]		
Category IV	.34	.47	.58	.42
Non-Category IV	.49	.45	.64	.50

[a]All correlations are significantly different from zero ($p < .05$).
[b]Correlations with the effects of MOJ partialled out.

Comparisons of Job Duties for Category IVs and Non-Category IVs

Each subject was interviewed to identify tasks he typically performed in his job. Differences related to AFQT were not found either for frequency or types of tasks reported. Category IVs performed the same tasks with the same frequency as Non-Category IVs.[14]

Although a man's AFQT was not related to the frequency with which he performed different types of tasks, his job longevity was. In 27 of the total of 82 job duty categories for the four MOSs, length of job experience was related to frequency of task performance. This was not unexpected since some duties (for example, supervisory tasks) are clearly reserved for men with more experience and higher rank.

[14]In the Repairman MOS, in one category of task which was reported by more than 50% of all repairmen, there was a substantial difference related to AFQT. Parts Repair and Replacement tasks were performed by 67% of the Category IVs, as compared to 54% of the Non-Category IVs. This was the only finding of any consequence related to AFQT among 82 categories of job duties examined in four MOSs.

Comparisons of the Performance of Negroes and Caucasians

In the study, approximately 21% of the subjects were Negro. They represented one-fifth of the sample, but they differed quite distinctly from Caucasians with respect to the amount of time they had been in the Army. Of those men with up to two years in the Army, 17% were Negro; between two and six years, 21% were Negro, and beyond six years, 30% were Negro. As a group, Negroes have a higher average time in the Army than Caucasians.

The increase in the percentage of Negroes in the Army over time reflects their relatively higher rate of reenlistment. In conjunction with more time in the Army, Negroes tended to have more experience in the job. Figure 2.21 shows the relative proportion of Negroes and Caucasians in five intervals of time in the job (all four MOSs combined).

Negroes and Caucasians at Five Month-in-Job Periods *(percent)*

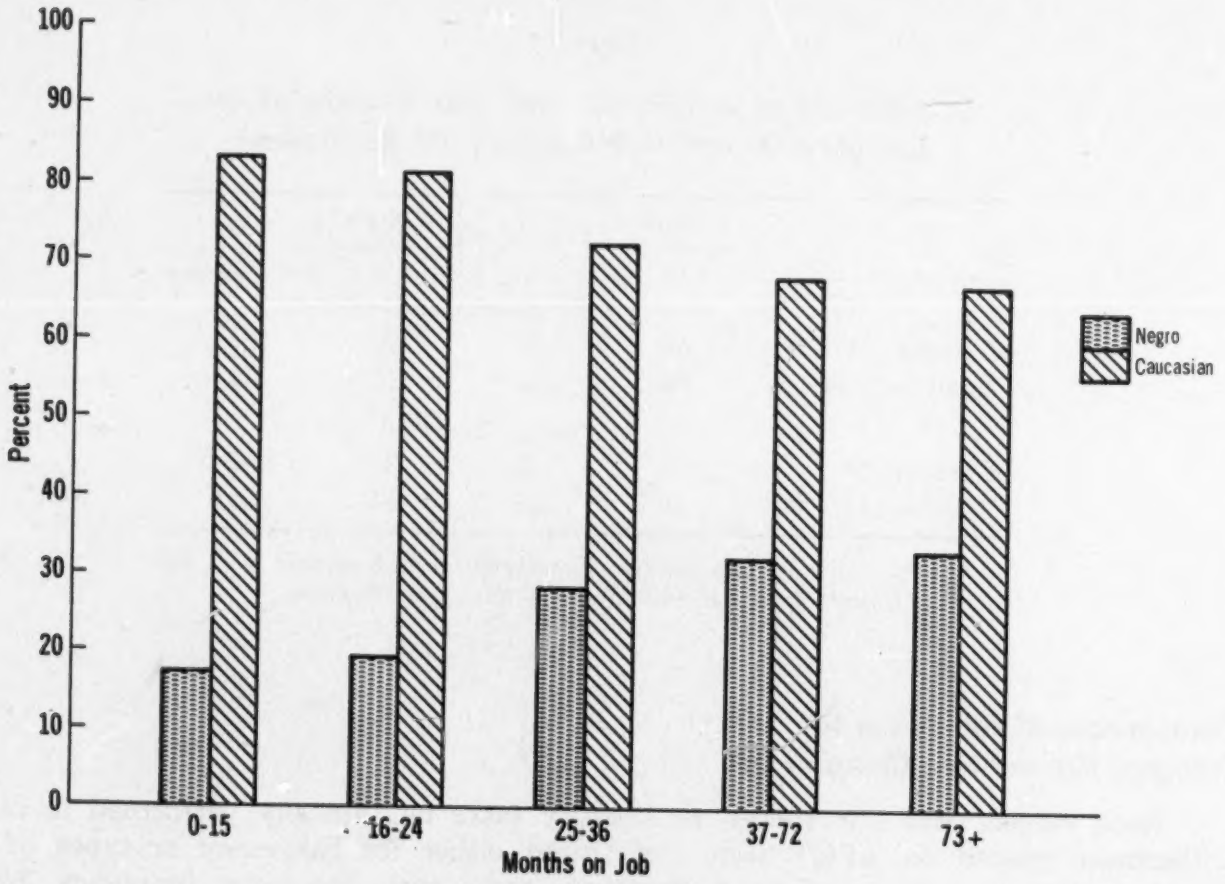


Figure 2.21

The difference between the Negro and Caucasian distributions is important since time in the job is a critical determinant of job performance.

In each MOS, Negroes and Caucasians also differed in their AFQT distributions. Figure 2.22 shows the relative proportions of Negroes and Caucasians for five levels of AFQT for all MOSs combined.

Differences described thus far among AFQT groups and MOJ groups are necessarily more representative of Caucasians since they comprise approximately 80% of the sample. Because the general distributions of AFQT and MOJ are different for Negroes and Caucasians, and the effects of these differences are expected to operate in opposition with regard to performance, the criterion scores of the two groups were compared.

Negroes and Caucasians at Five AFQT Levels *(percent)*

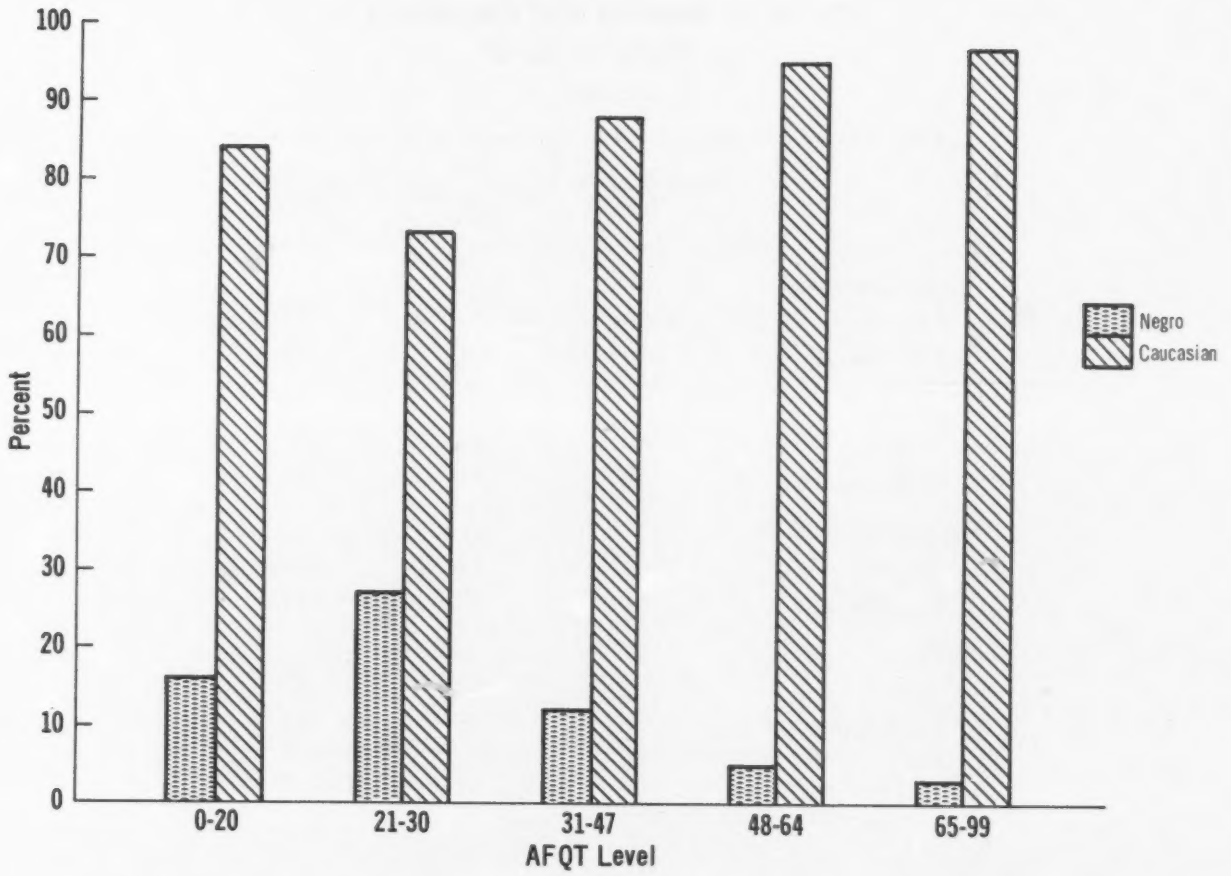


Figure 2.22

Means for Job Sample, Job Knowledge, and Supervisor Ratings are given in Table 2.8 in percent form. Analyses of these scores showed only one reliable difference—for Armor Crewman on the Job Knowledge test. The absence of any consistent difference between these groups, a uniform finding in four different MOSs on three criterion measures, provides strong evidence that the performance of Negroes and Caucasians, given their present AFQT and MOJ characteristics, is comparable across a range of jobs.

Several additional analyses were undertaken in which the differences in the AFQT and MOJ distributions for the Negro and Caucasian groups were statistically controlled (see Tables 2.9, 2.10, 2.11).

Table 2.12 shows means of variables used as statistical controls for analyzing differences between Negroes and Caucasians. To estimate performance differences attributable to the superior AFQT scores of Caucasians and to determine how these groups could be expected to compare if, at some future time, they had equivalent job experience, the groups were equated for MOJ and age, a related variable (but the AFQT advantage of Caucasians was allowed to operate). This analysis showed superior Job Sample test performance for Caucasians in only one MOS. Job Knowledge comparisons in three MOSs favored Caucasians and no differences appeared in the Supervisor Ratings.

To estimate performance differences attributable to the longer job experience of Negroes, the groups were equated for AFQT and the related variable, education (but the MOJ advantage of Negroes was allowed to operate). This analysis showed superior Job Sample test performance for Negroes in two MOSs. One comparison favored the Negroes on the Job Knowledge test. There were no differences on Supervisor Ratings.

Table 2.8

Means of Negroes and Caucasians on Three Criteria[a]

(percent)

	Job Sample Test	Job Knowledge Test	Supervisor Ratings
Armor Crewman			
Negro	64	59*	70
Caucasian	65	64	70
Repairman			
Negro	69	43	70
Caucasian	68	46	68
Supply Specialist			
Negro	59	54	68
Caucasian	60	53	70
Cook			
Negro	58	47	65
Caucasian	58	50	67

[a]The pair of means that is marked by an asterisk differ significantly from one another ($p < .05$).

Table 2.9

Means of Negroes and Caucasians on Three Criteria With MOJ Differences Controlled[a]

(percent)

	Job Sample Test	Job Knowledge Test	Supervisor Ratings
Armor Crewman			
Negro	61*	57*	66
Caucasian	66	65	70
Repairman			
Negro	66	41*	68
Caucasian	68	46	69
Supply Specialist			
Negro	57	52	67
Caucasian	60	53	70
Cook			
Negro	58	46*	64
Caucasian	59	50	67

[a]Analyses of Covariance were used to test differences between groups. In addition to controlling for MOJ differences, a related variable, age, was also controlled. Pairs of means that are marked by asterisks differ significantly from one another ($p<.05$).

Table 2.10

Means of Negroes and Caucasians on Three Criteria With AFQT Differences Controlled[a]

(percent)

	Job Sample Test	Job Knowledge Test	Supervisor Ratings
Armor Crewman			
Negro	68	63	69
Caucasian	64	63	70
Repairman			
Negro	73*	47	72
Caucasian	67	46	68
Supply Specialist			
Negro	62*	59*	68
Caucasian	59	51	70
Cook			
Negro	61	50	67
Caucasian	58	49	66

[a]Analyses of Covariance were used to test differences between groups. In addition to controlling for AFQT differences, a related variable, years of education, was also controlled. Pairs of means marked by asterisks differ significantly from one another ($p<.05$).

Table 2.11

Means of Negroes and Caucasians on Three Criteria With AFQT and MOJ Differences Controlled[a]

(percent)

	Job Sample Test	Job Knowledge Test	Supervisor Ratings
Armor Crewman			
Negro	64	61*	67
Caucasian	65	64	70
Repairman			
Negro	70	44	70
Caucasian	67	46	68
Supply Specialist			
Negro	61	55	67
Caucasian	59	52	70
Cook			
Negro	60	49	65
Caucasian	58	49	67

[a]Analyses of Covariance were used to test differences between groups. In addition to controlling for AFQT and MOJ differences, two related variables, years of education and age were also controlled. The pair of means that is marked by an asterisk differ significantly from one another ($p<.05$).

Table 2.12

Negro and Caucasian Means on Control Variables Used in Analyses of Covariance

	N	AFQT	MOJ	Education	Age
Armor Crewman					
Negro	73	24.3	51.8	11.5	26.2
Caucasian	297	42.2	33.9	11.1	23.4
Repairman					
Negro	49	22.6	35.0	11.6	24.6
Caucasian	335	41.1	20.8	11.0	22.5
Supply Specialist					
Negro	91	24.6	27.9	11.9	25.4
Caucasian	298	44.6	22.9	11.5	24.5
Cook					
Negro	68	24.9	31.2	11.5	23.4
Caucasian	291	40.3	21.8	11.3	22.4

Finally, in an analysis in which both AFQT and MOJ were controlled, no differences were found on the Job Sample tests, one comparison favoring Caucasians appeared on the Job Knowledge test, and again there were no differences on Supervisor Ratings.

In summary, from these analyses in which AFQT and MOJ are variously controlled, there is one fact of considerable import: Negroes, in spite of their lower average AFQT, perform their jobs as well as Caucasians in all but one MOS even when their advantage of greater job experience is removed.

Overall it may be concluded that for practical purposes the present performance of Negroes and Caucasians in the Army does not differ. This finding is particularly significant *if*, as some have speculated, the number of Negroes relative to Caucasians should increase in an All-Volunteer Army.[15]

Comparisons of the Performance of Inductees and Enlistees

Criterion performance of Inductees and Enlistees was compared. These comparisons were limited to subjects who were in their first 23 months in the Army. This subsample consisted of a total of 606 Inductees and 231 Enlistees for all four MOSs combined.

Out of the 12 comparisons on Job Sample tests, Job Knowledge tests, and Supervisor Ratings, only one reliable difference was found. Inductee Cooks were rated higher than enlistee Cooks by supervisors, despite the fact that these groups were identical on the other two criteria (Table 2.13).

Criteria of Acceptable Performance Based Upon Job Sample Data

One of the continuing problems faced in manpower assessment is the establishment of criterion levels of job proficiency that have functional utility. Data of this study provide an opportunity to establish an empirically based, operational definition of job proficiency defined by performance on work sample tests.

Ideally, minimum satisfactory performance would be defined in terms of specific operational requirements. The present state of human factors technology, however, does

[15] "Panel Proposes All-Volunteer Army," *Armed Forces Journal*, 28 February 1970, pp. 12-13.

Table 2.13

Means of Inductees and Enlistees on Three Criteria[a]
(percent)

	Job Sample Test	Job Knowledge Test	Supervisor Ratings
Armor Crewman			
Inductees	54	56	68
Enlistees	56	58	62
Repairman			
Inductees	62	42	68
Enlistees	59	40	63
Supply Specialist			
Inductees	55	45	70
Enlistees	52	44	64
Cook			
Inductees	56	47	67*
Enlistees	56	47	59

[a]The pair of means that is marked by an asterisk differ significantly from one another ($p<.05$).

not provide performance specifications that are sufficiently precise to allow this ideal to be achieved.

Examination of the scatter plots of job sample data suggest an alternative approach, a relative rather than absolute procedure for defining acceptable performance (Figures 2.23—2.25). The scatter plots showed a rather clearly defined floor of performance for men with more than 30 months of job experience. Here the vast majority of cases are seen to cluster in a rather narrow band of performance. Exceptions are seen in the 5-10% of the cases who are clearly deviant and fall below the floor. This band can be considered to represent, in effect, the range of normal and expected performance for experienced job incumbents. It, therefore, appears reasonable to adopt the lower limit of this band as defining minimal acceptable performance.

With such a definition, approximately 5-10% of the job incumbents with 30 or more months of experience are seen to fall below minimum performance standards. With the total sample being divided equally into Category IVs and Non-Category IVs it would be expected by chance that 50% of those below minimum acceptable performance would be Category IVs. The actual number is little higher - 60%.

An additional observation can be made by projecting the band of acceptable performance to include men in the 1-30 MOJ period. Approximately 26% of the Category IV group and 45% of the Non-Category IV group perform above the minimum acceptable level during the first 18 months of job experience. Between 19-30 MOJ, approximately 51% of the Category IV and 77% of the Non-Category IV groups perform above this minimum level.

Using Job Knowledge Scores to Screen Ineffective Performers at Time of First Reenlistment

A variety of findings in this study suggest that it is reasonable for the Army to continue its present policy of accepting men at the lower AFQT levels: the great variability in performance at the outset of job experience, the extreme overlap in

Job Sample Data: Cook

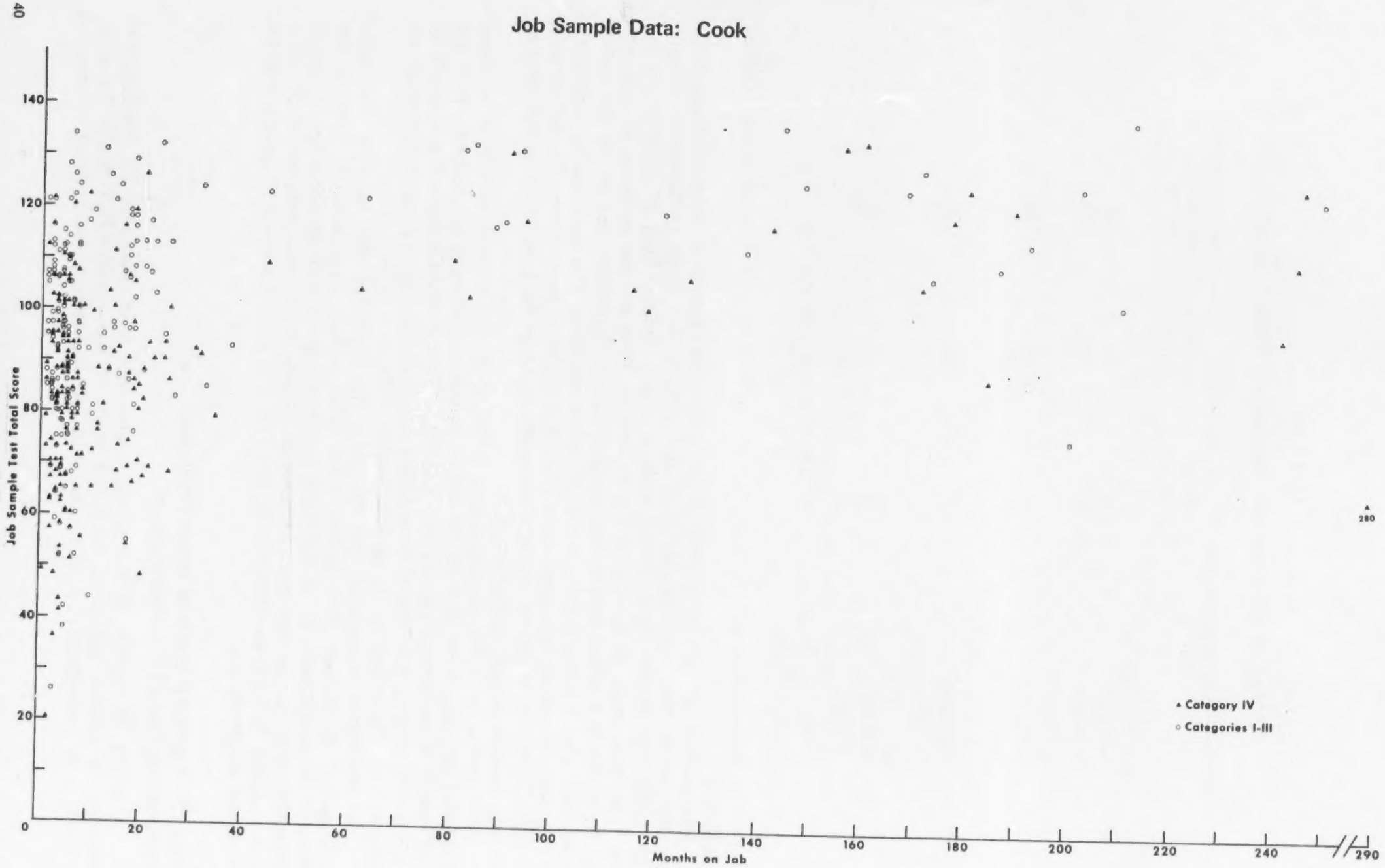


Figure 2.23

Job Sample Data: Armor Crewman

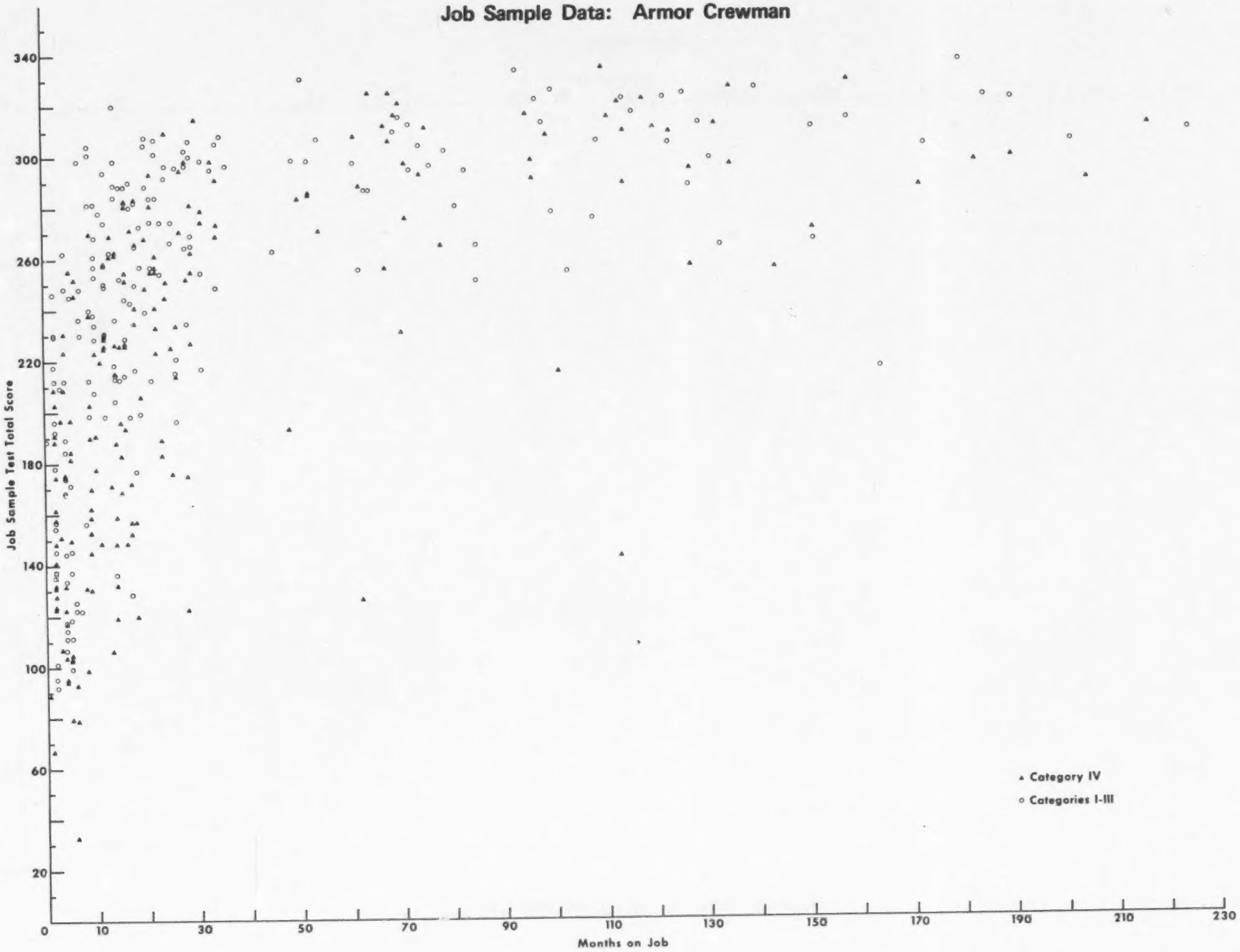


Figure 2.24

Job Sample Data: Supply Specialist

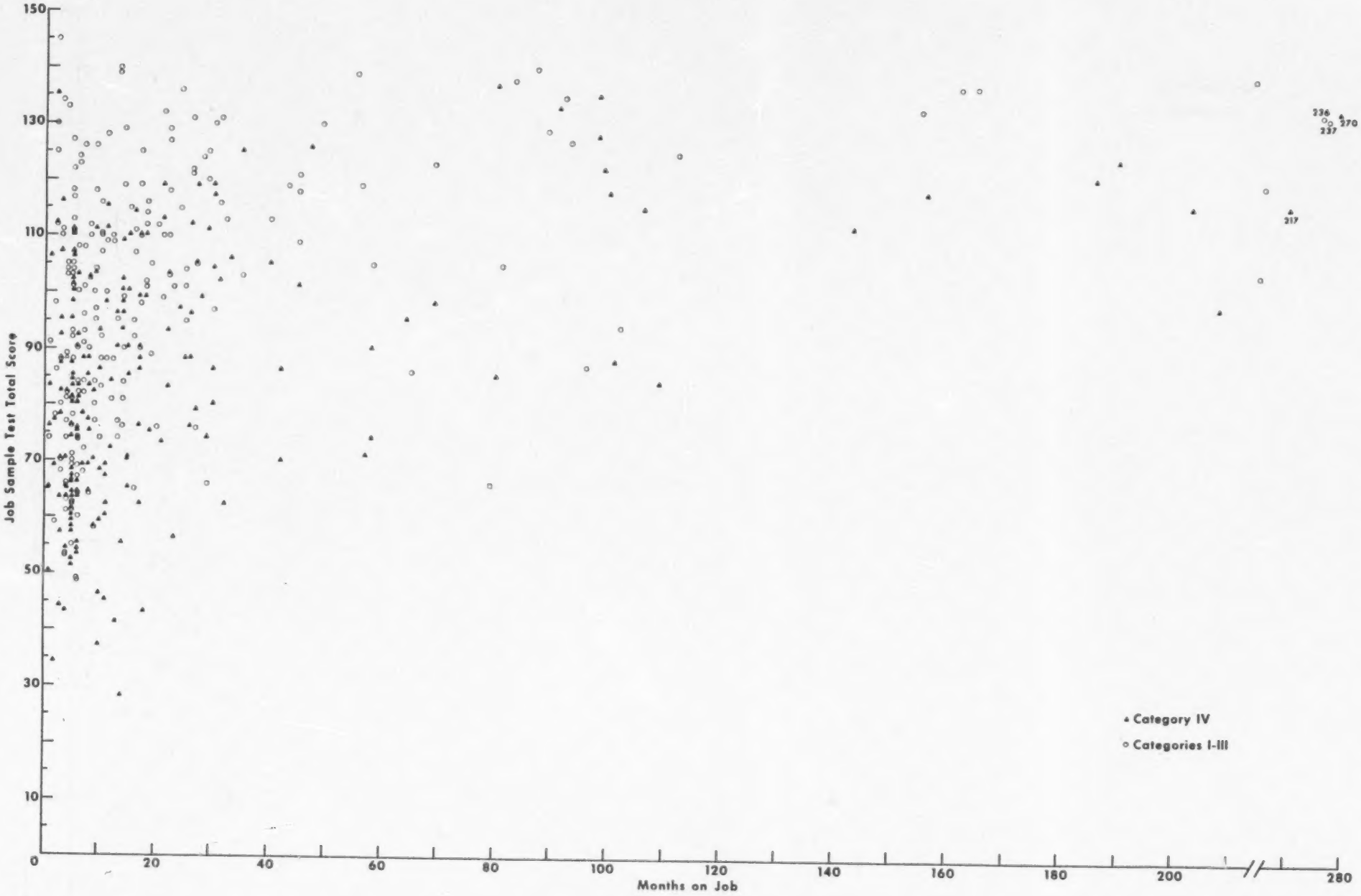


Figure 2.25

performance over the entire range of time in the job, and the potential loss of large numbers of low aptitude men who perform as well as their counterparts with higher AFQT scores.

Rather than excluding low aptitude men from the military, it would appear reasonable for the Army to consider screening out those men who continue to perform in the lower ranges of the distribution after they have acquired some degree of job experience. While for screening, tests such as the Job Sample measuring instruments used in the research would provide the most valid measure of a man's performance capability, such tests would be prohibitively expensive for operational use. Fortunately, a test modeled after the Job Knowledge test would appear to be an excellent candidate as an alternative screening instrument. Such tests, similar to existing Army proficiency tests in cost and administrative simplicity, correlated substantially with Job Sample tests in the UTILITY study. These correlations had the further virtue of remaining relatively high for the restricted Category IV and Non-Category IV subsamples. (Tables 2.6 and 2.7)

The Job Knowledge test could be used to establish whether a man should be retained in the service in his job specialty. Screening, using Job Knowledge tests, could occur at the time of a man's first reenlistment. Job experience during an initial military tour appears to provide sufficient job exposure to give even the poorest performers an opportunity to learn and demonstrate their capabilities.

In the previous section, minimum acceptable levels of performance for men with considerable experience were discussed. The correlation between Job Knowledge scores and performance (i.e., Job Sample scores) can be used to predict the ratio of acceptable performers to unacceptable performers that would be the case for any given minimum score set on the Job Knowledge test. A minimum Job Knowledge score can be set for retention by considering two factors: the size of the manpower pool in relation to personnel requirements; the trade-off between risking rejection of acceptable performers and assuring that unacceptable performers are not retained. Thus, where personnel needs are minimal, high Job Knowledge cut-off points could be used which would tend to assure retention of few unacceptable performers at the cost of rejecting some acceptable ones. When personnel needs are great, it would be possible to set lower levels in order to avoid losing some of the acceptable performers at a cost of retaining a greater proportion of unacceptable performers.

It is believed that such a procedure is feasible and would provide an effective screening technique. Establishing the method on an operational basis requires construction of job sample tests in each MOS where screening is to occur. (UTILITY data provide evidence that job sample tests requiring the performance of only a few tasks would be adequate for this purpose.) Job knowledge and job sample data would need to be collected using a large sample of men who have spent approximately 18 months on the job (two years in the Army).[16,17]

[16] While Proficiency Tests currently in use in the Army might be adapted as job knowledge tests, considerable care is necessary in the development of these instruments. To be used as screening instruments job knowledge tests must correlate with job sample tests at least as well as those in the present study. Job knowledge tests used operationally in the Army vary greatly in quality. Many require information that is not directly related to job performance. Test items are generally developed by subject matter experts rather than job holders and tend to emphasize theory, nomenclature, and technical minutiae rather than job specifics. If such tests were adopted directly, there is little evidence that correlations of an appropriate magnitude would be obtained.

[17] To the extent that job knowledge items are common across job families or clusters, it would be feasible to incorporate them into one test for the job cluster, thereby reducing the number of tests that would be needed.

SUMMARY

The findings of this study are descriptive of and restricted to men who were working on a continuing daily basis in four different military jobs. While different jobs were studied no distinctions are made between MOSs in this summary since the findings were so similar:

1. Job performance is directly related to both AFQT and job experience. Job experience, however, shows a more profound effect than AFQT. While average performance of different AFQT groups shows separation up to approximately 5 years in the job, with time an increasing proportion of men at all AFQT levels appear in the upper ranges of the performance distribution. The data suggest the potential loss of a sizable number of good performers if entry requirements were modified to exclude from service those men with AFQT scores below 20.

2. Beyond 30 months of job experience, there is a clear and stable floor of performance. This floor could be used to define minimum acceptable performance.

3. Job Knowledge scores correlated more highly with Job Sample scores than any other variable in the study (except job experience).

4. Supervisor Ratings (scales of the Commander's Evaluation Report) do not differentiate men at different AFQT or job experience levels. The ratings are highly skewed toward the favorable end of the scale and bear only a moderate relationship to Job Sample and Job Knowledge criteria.

5. AFQT is not related to the types of tasks a man is assigned in his job, nor to the frequency with which he performs them.

6. The job performance of Caucasians and Negroes does not differ despite the lower average AFQT of the latter.

7. Job performance of Inductees and Enlistees does not differ during their first 23 months in the Army.

The primary implications, based upon the results of this study, are:

1. The Army could continue its present policy of accepting men at lower AFQT levels. If the present policy of accepting men from the lower AFQT ranges into the Army were to continue, a sizable proportion of the lower aptitude men would perform at acceptable levels.

2. Screening for retention could be undertaken at the time of the first reenlistment. Such screening could be based at least partly upon scores obtained in Job Knowledge tests. In addition, a man's record of conduct in the military prior to the time of reenlistment would undoubtedly be useful in conjunction with this Job Knowledge test score.

3. Supervisor Ratings (Commander's Evaluation Report) provide evaluations of general personality characteristics rather than of job proficiency; they are highly susceptible to rater bias, and they fail to provide any fine discriminations between men with regard to job performance.

Chapter 3

LITERACY SKILLS IN RELATION TO JOB PROFICIENCY IN SELECTED ARMY JOBS—WORK UNIT REALISTIC

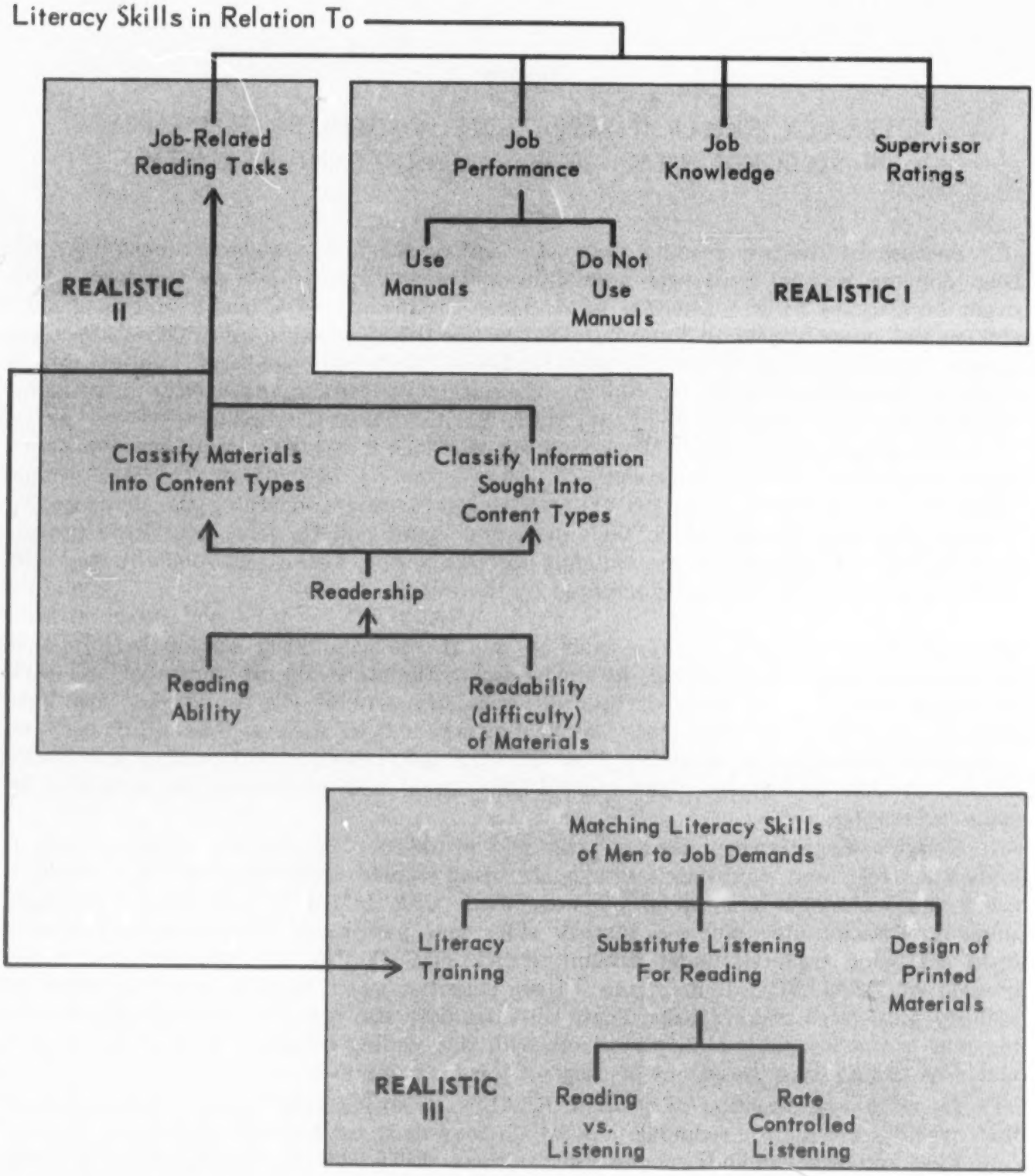
Because of the low reading skills of many of the "new standards" men, there has been concern among manpower specialists that many of these "new standards" men might be assigned to jobs wherein the demands for reading skills might far exceed their ability, and possibly lead to job failure. To reduce this possibility, information about the literacy capabilities of Army personnel and the literacy demands of military jobs is needed. Therefore, in 1968, to obtain information concerning the literacy demands of military jobs, the Deputy Chief of Staff for Personnel, Department of the Army, requested HumRRO to initiate Work Unit REALISTIC. REALISTIC is an acronym based upon the literacy skill areas studied—*REAding*, *LIStening*, and *ArithmeTIC*. The general objectives of the research are to (1) provide information concerning the demands for reading, listening, and arithmetic skills in several major military jobs, and (2) to provide information and suggestions for reducing discrepancies between personnel literacy skill levels and the literacy skill levels required by the job.

To accomplish these objectives, work on REALISTIC has been undertaken in three Work Sub-Units (Figure 3.1). To examine the effects of literacy on job performance, relationships among the reading, listening, and arithmetic skills of personnel and their performance on one or more of four different measures of job proficiency have been studied. As Figure 3.1 indicates, the proficiency indices used include proficiency on job-related reading tasks, proficiency on "hands-on" Job Sample performance tests, proficiency on Job Knowledge "paper-and-pencil" tests, and proficiency as measured by supervisor ratings.

Relationships between literacy skills and proficiency on the job performance test, knowledge test, and supervisor's ratings are being studied under sub-unit REALISTIC I, using data collected in conjunction with Work Unit UTILITY and, hence, the same subjects. Relationships between literacy skills and performance on job-related reading tasks are being explored under sub-unit REALISTIC II. The activities included in the domain of REALISTIC II in Figure 3.1 are activities which have been accomplished to identify job-related reading tasks. These activities have also provided information concerning how a man's reading ability interacts with the reading difficulty level of job reading materials to influence the extent of usage of job reading materials.

An additional direction of effort in REALISTIC III has been to identify information that provides a basis for reducing gaps which may exist between an individual's literacy skill level and the demands of the job for these skills. This activity has involved some experimental work, primarily in regard to listening, but is mainly based on a literature survey. As indicated in Figure 3.1, we have considered reducing discrepancies between the skills people have and the skills needed for the job by either modifying the person through literacy training, or by modifying the job demands. In the latter case, we have considered the substitution of listening for reading demands, and the redesign of job and training aids to make them less demanding of literacy skills.

In the following discussion, research dealing with how reading ability, with its attendant language component, may exercise a pervasive influence on a man's information seeking and processing on the job is described first.



Organizational chart for Work Unit REALISTIC. In Sub-unit REALISTIC I, literacy skills are related to performance on job performance, knowledge, and supervisor ratings. In REALISTIC II, literacy skills are related to job-related reading tasks. In REALISTIC III, methods of matching literacy skills of men to literacy demands of jobs are considered.

Figure 3.1

Following the examination of the on-the-job reading practices of men in selected jobs, consideration is given to the relationships observed between reading ability and the four indices of job proficiency presented in Figure 3.1.

LITERACY AND ON-THE-JOB READING BEHAVIOR

This section presents data showing how the difficulty level of printed job materials and the lack of reading skill may interact to influence the extent of usage of job reading materials. Data also shows how reading ability relates to the practice of asking and listening to others for job-related information, and to the extent and nature of usage of arithmetic on the job. These data were collected under REALISTIC II in the course of identifying job reading materials for use in the construction of job reading task tests.

Three Army jobs were studied: General Vehicle Repairman (MOS 63C), Unit and Organizational Supply Specialist (MOS 76Y) and Cook (MOS 94B). These jobs were selected for study because they represent a range of literacy demands as determined from the job requirements stated in AR 611-201.[1] These jobs were included in both the REALISTIC I and UTILITY work. There is, thus, a comprehensive base of knowledge about these jobs and about the men working in them.

The Structured Interview

To obtain information about job reading materials and use of reading, listening, and arithmetic on the job, a structured interview was administered to men in the target jobs at their duty stations at Fort Ord, California, and Fort Carson, Colorado. The men were selected for interview on the basis of reading grade level scores, with the additional restriction that the total time in the job fall between one and 18 months. Also, because of the high (r=.65) correlation of reading and AFQT, these variables were permitted to covary. Thus, in the analyses which follow, the low reading group (4—6.9) consists primarily of men from AFQT Mental Category IV, while the men in the higher reading groups are largely from the Non-Category IV groups.

DIFFICULTY OF JOB-RELATED PRINTED MATERIALS IN RELATION TO READING ABILITY

By means of the interview, job reading materials were identified. Copies of these materials were subsequently obtained and evaluated to determine their reading difficulty levels. This assessment was accomplished by means of an available "readability" formula, that is, a formula for estimating how easy it is to read and understand a publication.

Table 3.1 presents a summary of the readability analyses. It shows the total number of publications and pages sampled in each MOS, the range of reading difficulty levels found over all pages, and the average grade level of readability of materials in the MOSs.

The averages in Table 3.1 are shown graphically in Figure 3.2. In this figure, the average grade level of readability of materials is indicated by the dotted bars. Included also in Figure 3.2 is an indication of the average reading grade level scores of a sample of Army personnel working on jobs within each of the MOSs. In Figure 3.2, the reading ability data are provided separately for Category IV and Non-Category IV men.

[1] Department of the Army. *Manual of Enlisted Military Occupational Specialties*, Army Regulation 611-201, Washington, April 1966, with amendments.

Table 3.1

Readability Scores for Publications in Three Army Jobs

MOS	Number of Publications	Number of Pages Sampled	Range of Flesch Readability Levels – SGE*	Average Readability SGE*
Supply Specialist	11	64	8.5 – 16+	16+
Repairman	8	244	7.0 – 16+	14.5
Cook	6	100	6.0 – 14.5	9.0

*SGE=School Grade Equivalent

Readability of Publications and Reading Ability of Job Incumbents

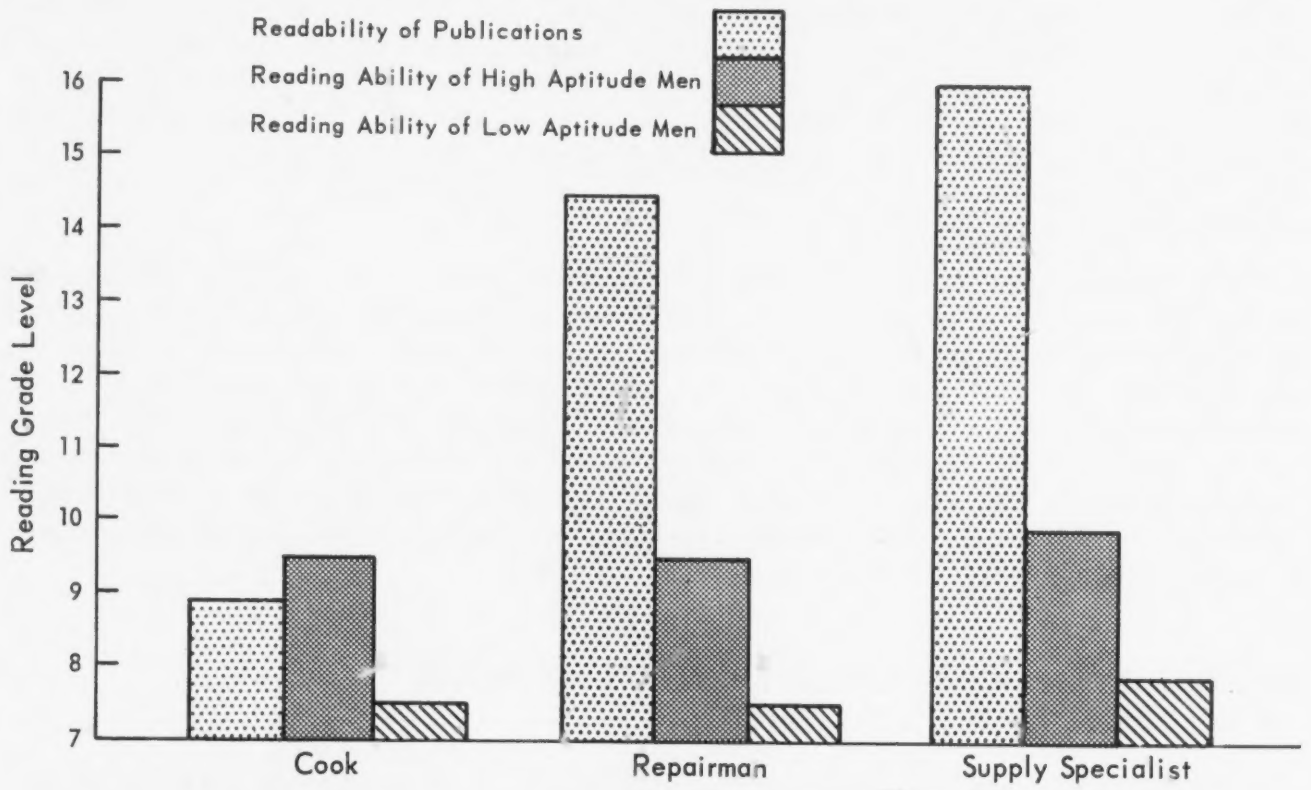


Figure 3.2

In making the visual comparisons between readability and reading ability in Figure 3.2, it can be noted that the difficulty level of printed materials for the Supply and Repairman jobs exceeds the average reading achievement levels of the Non-Category IV men by about five to six grade level points. For the Cooks, however, difficulty level of the printed job materials and the reading achievement level of the higher aptitude personnel are almost numerically matched. Category IV Cooks present an average reading achievement level that falls only about two grade level points below the reading difficulty level of their materials. Since the readability formula provides a roughly accurate index of the difficulty of the materials, Figure 3.2 suggests that both high and low aptitude personnel would experience considerable difficulty in reading and comprehending the Supply Specialist's and Repairman's job materials.

Readability, Reading Ability, and Readership

In the fields of journalism and advertising, the effects of the reading difficulty level of materials on the readership of the materials has been examined. Studies have indicated that, if materials are written at too high a level of difficulty, the readership (i.e., number of people who read the materials) may drastically decline. For this reason, the study included determining whether the gap between the reading ability of the men in an Army job and the reading difficulty level of the printed materials might influence the extent to which men reported the use of job-related reading materials. The possibility that men of poorer reading ability might avoid reading material and instead tend to listen (i.e., ask others) for job information to a greater extent than the more able readers, was also studied.

Figure 3.3 presents data bearing on the readership and extent of listening for men of three reading skill levels and for Supply Specialists, Repairmen, and Cooks.[2]

Statistical analyses and the data of Figure 3.3 indicate that for Supply and Repair personnel, a clear relationship obtains between reading ability and reported use of job-related reading materials so that, the more able the reader, the greater the reported use of printed materials. For Supply Specialists, the readers in the grades 4—6.9 reading

Citation of Reading and Listening Information Sources by Reading Ability Level

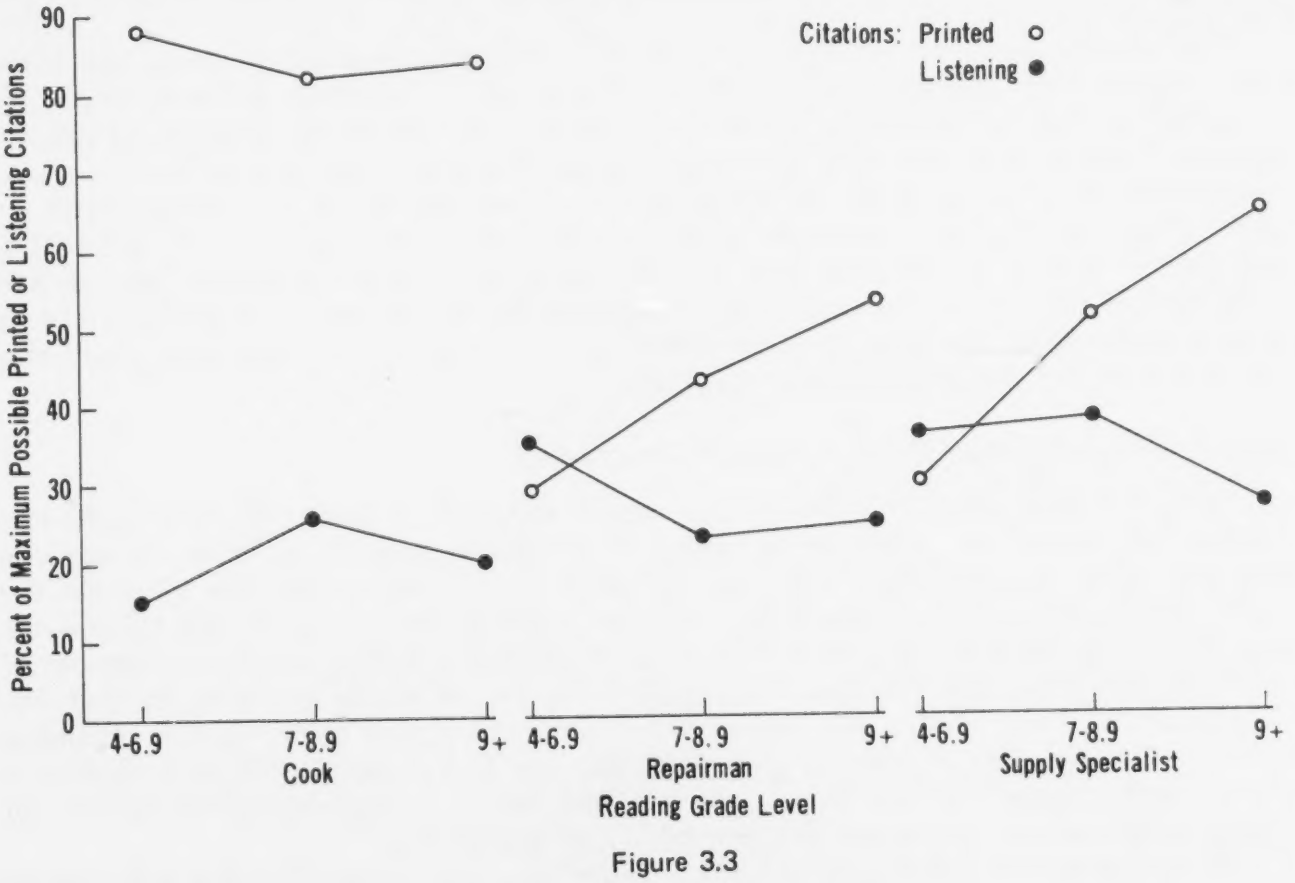


Figure 3.3

[2]The readership index expresses the number of printed sources used that were cited by job incumbents as a percentage of the maximum number possible, each man having been given a limit of five citations. Thus, a readership index of 20 means that the particular group of men produced, on the average, one citation of the use of printed material out of a possible five requested, and so on. The listening index was computed in the same manner as the readership index.

group gave only 30% of the maximum possible citations of use of printed materials, as contrasted with nearly 65% of maximum for the group of readers in the grades 9+ range. For Repairmen, the readership increased from 30% to 50% of maximum as a function of reading ability.

It is notable that Cooks reported a high (greater than 80%) incidence of use of printed materials, and this was independent of reading ability. A possible reason for this is discussed below.

The data for listening (i.e., obtaining job task information by asking someone) indicate a fairly constant use of listening over the three reading level groups in each job. In the Supply and Repairman jobs, the listening index is slightly higher than the readership index for the lower reading groups. However, with these small groups, these differences are not statistically significant.

Discussion of the Data on Reading Ability, Readability, and Readership

The data presented above show a remarkable degree of consistency. In addition, the relationships observed among reading ability, readability, readership, and listening appear to follow a very logical course. Where reading materials are difficult, as in the Repairman and Supply jobs, there is less tendency for readers of any level to use the materials, although the higher reading ability men will use them more than the less able readers. If the job materials are quite difficult, and the man cannot read very well, he may seek proportionately more of his information from others, rather than from reading the job materials.

The present data on readability, reading ability, and readership across the three MOSs suggest that stimulating an increased usage of job reading materials might be accomplished both by improving literacy skills of the men and by the redesign of reading materials. Furthermore, the data for Cooks suggest that greater gains in readership might be expected from the redesign of materials than from increasing the literacy skills of men. In this regard, much research on the construction and evaluation of various job performance aids has indicated that by following a systems approach, job printed materials can be designed which greatly improve the effectiveness of job incumbents across a spectrum of aptitude. It seems likely that the provision of such aids would also increase the utilization of job printed materials.

Reading Ability and the Use of Arithmetic On-the-Job

Table 3.2 summarizes the data on the use of arithmetic in these jobs. The arithmetic citations are stated in terms of percent of maximum citation possible, as for the readership and listening index numbers reported above. Table 3.2 also indicates the nature of the arithmetic comprising the citations made by men. Thus, for the Repairmen, those of reading level 9+ gave only 15% of the maximum possible citations of the use of arithmetic. Of these few citations, 5% involved the use of whole numbers, another 5%, decimals or fractions, 27%, some system of measurement (i.e., a money system, changing inches to feet, pounds to ounces) and 63%, the use of a measurement tool, such as a ruler or some gauge. In the Repairman job, the use of gauges (torque wrenches, air pressure gauges, etc.) represented the primary use of arithmetic.

Of special note in the Supply job is the lower incidence of use of whole numbers by higher reading ability men, and their higher frequency of use of a system of measurement. The data indicate that the higher reading ability men tend to work more with the money system in the Supply MOS than do the less able readers. The latter in turn do mostly simple counting tasks involving whole numbers. The Cook data bear out the importance of systems of measurement in the use of recipe books. This was true regardless of reading level.

Table 3.2

Use of Arithmetic as a Function of Reading Ability

(Use of Arithmetic is in Percent of Maximum Citations Possible)

MOS	Reading Level	Arithmetic Citations (Percent)	Percent of Citations Using:			
			Whole Numbers	Decimal/ Fractions	System of Measure	Measurement Tool*
Repairman	9+	15	5	5	27	63
	7–8.9	6	9	0	27	64
	4–6.9	9	8	0	0	92
Supply Specialist	9+	38	32	9	54	5
	7–8.9	33	73	0	27	0
	4–6.9	28	71	0	29	0
Cook	9+	32	33	0	63	4
	7–8.9	29	35	0	65	0
	4–6.9	33	29	0	68	3

*ruler, gauge

Overall then, these data indicate a fairly low usage of arithmetic in these jobs. However, when used, the nature of the arithmetic task is likely to be different for each MOS, and, in the case of Supply, for different reading ability groups. Thus we find that Repairmen use mostly gauges, while Cooks use the measurement systems involved in preparing recipes. In the Supply MOS, low or average reading ability men do simple counting, and higher reading ability men work with money and accounting.

READING SKILLS RELATED TO PROFICIENCY ON JOB-READING TASK TESTS

The primary objective of Work Sub-Unit REALISTIC II has been to identify job reading tasks and to evaluate the relationships of performance on the job reading tasks to performance on a standardized reading achievement test. Job reading materials were identified by means of the structured on-the-job interview. Copies of the printed materials cited as being used on the job by the men in the Supply, Repairman, and Cook MOSs were obtained. From these materials, reading task tests were constructed that represent the most frequently mentioned reading materials, and that require the man being tested to seek the kind of information from the materials which job incumbents reported seeking. Separate tests were constructed using the materials from each of the three jobs.

The reading task tests and the standardized reading test (SRT) (described later in this chapter) were administered to several hundred Army inductees at the reception center at Fort Ord, California. In addition, scores are being obtained on the two tests for men who have been assigned to one of the target jobs and who have just completed Advanced Individual Training in their job area. Data from the new Army inductees indicate relationships of reading ability to performance in the job reading tasks for men who have not been specially selected for the job for which the reading task was constructed. Data for the second group of men indicate relationships of reading ability to

performance on job reading tasks for men specially selected and trained for working in the given job.

Table 3.3(A) shows the correlations of performance for the SRT and for the AFQT with performance on the job-related reading tasks for new Army personnel. Table 3.3(B) shows similar (but as yet incomplete) data for personnel who have completed AIT in that job area. In Table 3.3(A), the SRT and AFQT correlate to about the same extent as do AFQT and performance on the reading task tests. There is also a notable consistency in the fairly high relationships of performance on the SRT to job reading task test performance.

Table 3.3

Correlation Coefficients Showing Degree of Relationship of Reading Ability and AFQT to Performance

(A)	Job-Related Reading Task Test: New Army Personnel					
	Repairman		Supply Specialist		Cook	
		(N)		*(N)*		*(N)*
Standardized Reading Test[a]	.76	200	.78	222	.76	193
AFQT[a]	.66	199	.65	221	.62	191

(B)	Job-Related Reading Task Test: Men at End of Advanced Individual Training					
	Repairman		Supply Specialist		Cook	
		(N)		*(N)*		*(N)*
Standardized Reading Test[a]	.62	114	.56	49	.74	108
AFQT[a]	.67	89	.45	40	.56	68

[a]The correlation between AFQT and Standarized Reading Test (SRT) scores for these personnel equals .65.

The data of Table 3.3(B) are based upon results obtained to date from an in-progress testing program. Hence, the numbers of men are not large enough for stable results. In comparison with 3.3(A), there is the suggestion of an attenuation in the relationships between reading ability and reading task performance when men have been specially selected and trained in a job. This is to be expected if the selection and training process is performing a "homogenizing" effect—that is, if the men of differing reading levels are being "made" more alike by the selection and training procedure.

To gain a better notion of the reading skills required to perform the job reading tasks, Figure 3.4 is presented. This figure shows the percentage of men new to the Army at or above three different criterion levels of performance on the reading task test in relation to the reading ability level of the men as determined by the SRT.

The vertical broken line in each section of Figure 3.4 designates a reading skill level of 8.0, a level frequently referred to as *functional literacy* (a considerable increase from the 4.0 level of functional literacy established in World War II). The data for the Cooks show that 100% of the people who read at the 8th grade level would pass the criterion score on the Cook reading test whether this criterion were set at 50%, 60%, or 70% correct. For the Repairman reading tasks, however, of those reading at the 8.0 level, only

Men at Each Reading Grade Level Reaching Different Criterion Level on Reading Task Test *(percent)*

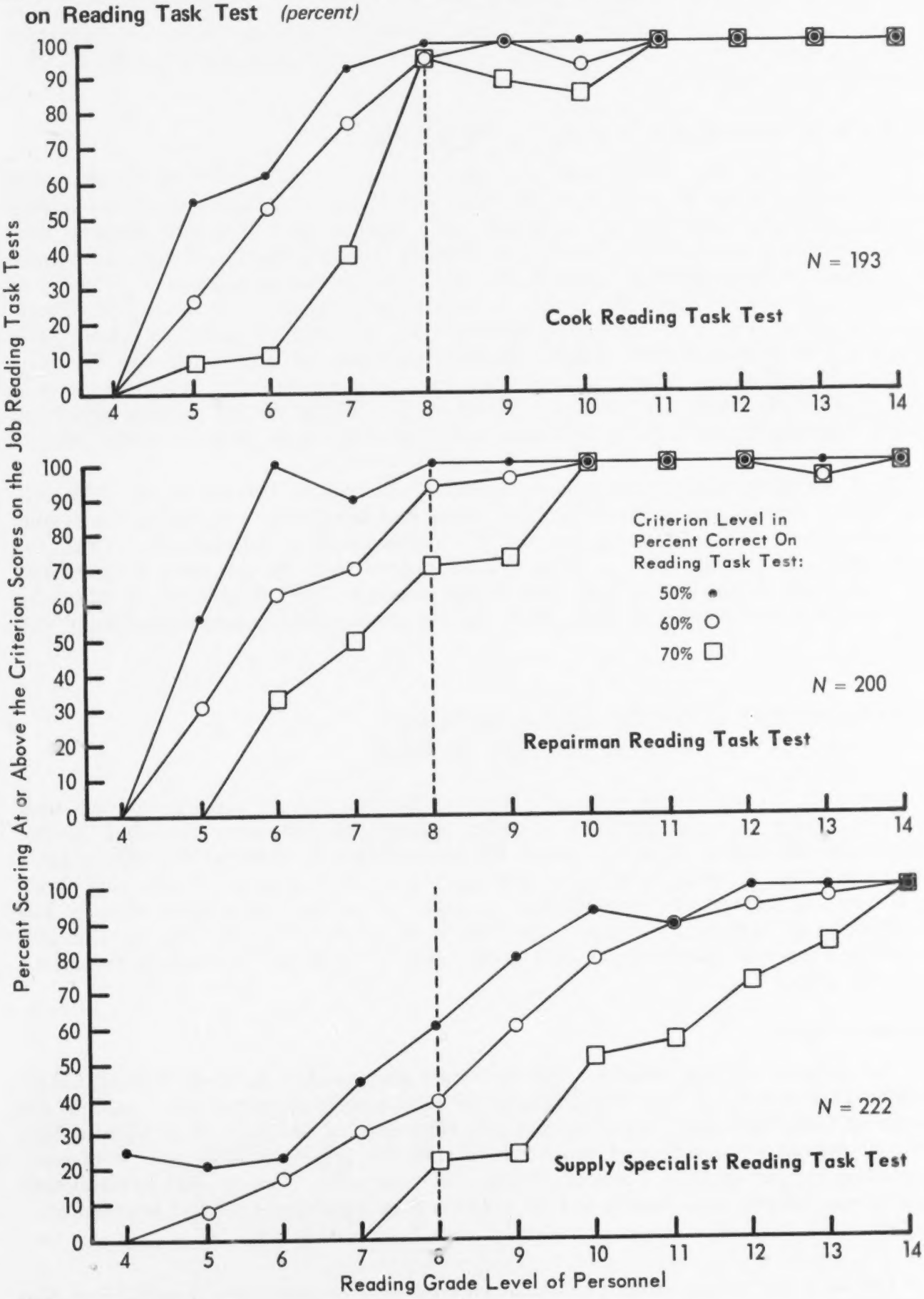


Figure 3.4

70% would be expected to surpass the 70% correct criterion level. For the Supply reading tasks, the situation worsens, since only 20% of persons with a reading level of 8.0 would be expected to get 70% correct. Thus there are clear differences in the reading skills needed for men not trained in the job to use the printed materials from the three MOSs. This is discussed below.

Readability of Materials and Reading Task Performance

The above analyses substantiate the data on the difficulty of materials presented earlier in this chapter where it was indicated that the reading difficulty of the Supply material was higher than that of the Repairman, which in turn was more difficult than that of the Cook (Figure 3.2). The data for reading task performance (Figure 3.4) appear to substantiate the readability data, in that the Cook's material appears to impose less difficulty than the Repairman's, which in turn is less formidable than that of Supply. From the point of view of job reading material then, the need for advanced reading skills appears to be greatest for the Supply Specialist job, with the Repairman and the Cook following in that order. If one were to consider a functional reading level to be one at which 80% of the readers would be expected to get 70% of the job reading task items correct, then functional literacy for Cooks would be in the range of grade levels 7.0—7.9, for Repairmen, 8.0—8.9, and for Supply Specialists, 12—12.9.

It is likely, however, that through Advanced Individual Training in an MOS area, classification factors, learning of "jargon" terms and familiarity with the job materials will permit less able readers to use the job materials more satisfactorily. Thus, the incomplete data for the men in Table 3.3(B) suggest that, by the criteria established above (i.e., 80% of the people pass 70% of the items) a 7.0—7.9 level would suffice for both the Cook and Repairman jobs, while the Supply Specialist would require a 9.0—9.9 level.[3]

LITERACY IN RELATION TO JOB KNOWLEDGE, JOB PERFORMANCE, AND SUPERVISOR RATINGS

Earlier in this chapter relationships between performance on job reading task tests and performance on a standardized reading achievement test were examined. In this section, consideration is directed toward the examination of relationships among three literacy variables (reading, listening, arithmetic) and three indices of job proficiency which were *not* designed to measure reading skills, at least not in a direct manner. The job proficiency indices were those used in Work Unit UTILITY and include: Job Knowledge (paper-and-pencil tests), Job Performance ("hands-on", job sample tests), and supervisor ratings.

Research Subjects

The subjects of this research were the same men studied in Work Unit UTILITY (Chapter 2), Category IV and Non-Category IV men who were paired with regard to the amount of time they had worked on the job. However, for the purpose of REALISTIC, the only import of this pairing procedure is that the lower aptitude men were over-represented in our sample. For this reason, the figures for literacy skill levels simply describe our sample, and should *not* be construed as parameters of the *general* Army population.

[3] Additional data bearing on this problem are presently being collected under HumRRO Work Unit READNEED.

Literacy and Other Predictor Measures

Reading—To assess reading skills, the Survey of Reading Achievement, Junior High Level (grades 7—9) developed by the California Test Bureau was used.

Arithmetic—Arithmetic skills were measured by use of the Survey of Arithmetic Achievement, Junior High Level, California Test Bureau, a companion test to the reading instrument.

Listening—Listening skills were measured by a non-standardized experimental test constructed for this project. It consists of three short descriptive passages presented orally on tape. After each passage, 12 questions, calling for information contained in the passage, are read aloud twice, and after each question the subject is required to give his single word or short phrase answer. (When the passages are regarded as reading material, they fall at the 6th, 7th, and 14th grade level of reading difficulty.)

Research Findings

The ultimate objective of the data analysis is to determine how well performance on one or more of the predictor variables predicts performance on the various job proficiency measures. First, however, it is informative to note how performance on the literacy tests and AFQT was distributed in the groups of men studied in the four jobs.

Table 3.4 shows number and percentage of men at various proficiency levels on the three literacy tests and the AFQT. These figures are for the four MOSs combined. It is interesting to note that, although half the total sample was from AFQT Mental Category IV, less than 10% of the population read below the 6.0 grade level, and fewer than 18% performed below the 6.0 grade level in arithmetic.

This seems to contrast with Department of Defense data on "New Standards" men (primarily with scores in the lower half of the AFQT Mental Group IV range) which show some 47% of these men scoring below the 6.0 level in reading and 41% below the

Table 3.4

Distribution of Subjects by Literacy and AFQT Level

(Percent)

Reading			Arithmetic			Listening			AFQT		
Score*	*N*	%	Score*	*N*	%	Score	*N*	%	Score	*N*	%
4–4.9	31	2.0	4–4.9	38	2.4	1–4	22	1.4	1–10	24	1.5
5–5.9	108	6.9	5–5.9	238	15.2	5–8	51	3.3	11–20	374	23.9
6–6.9	228	14.6	6–6.9	295	18.9	9–12	146	9.3	21–30	384	24.6
7–7.9	328	21.0	7–7.9	424	27.1	13–16	308	19.7	31–40	190	12.1
8–8.9	233	14.9	8–8.9	184	11.8	17–20	381	24.3	41–50	139	8.9
9–9.9	273	17.5	9–9.9	142	9.1	21–24	353	22.6	51–60	141	9.0
10–10.9	168	10.7	10–10.9	74	4.7	25–28	230	14.7	61–70	131	8.4
11–11.9	55	3.5	11–11.9	52	3.3	29–32	73	4.7	71–80	75	4.8
12–12.9	83	5.3	12–12.9	37	2.4	33–36	0	0	81–90	73	4.7
13 & up	57	3.6	13 & up	80	5.1				91–100	33	2.1
Total	1564			1564			1564			1564	

*Score = School Grade Equivalents

6.0 level in arithmetic.[4] Thus, our data show a considerably smaller percentage of men at the lower literacy levels than would be expected in light of the data reported for "New Standards" lower aptitude men. The reason for this is not clear. It may be due in part to the requirements for classification to these MOSs and, perhaps, to differential attrition throughout the training and assignment sequence.

Differences among the four MOSs in performance on the literacy tests are presented in Table 3.5. This table shows the percentage of men in each MOS who scored below the grade 7.0 level on the reading and arithmetic tests, and below a raw score of 13 on the experimental listening test. With regard to reading, the percentage of men reading below the grade 7.0 level in Supply is less than one-half that of the Cooks where fully one-third read below the 7.0 level. The Repairman and Armor Crewman jobs occupy a midpoint between Supply and Cook. It is interesting to recall from earlier portions of this chapter that the reading materials in the Supply MOS are most difficult, and the Cook the least difficult, with the Repairman in between. If men were being assigned to these three jobs on the basis of the reading difficulty of the materials, the assignment would reflect the reading achievement distributions in Table 3.5. That is, since Supply has the most difficult reading materials, one would not want to assign many poorer reading men to that career field. However, since the Cooks' reading materials are much easier, men of lower reading abilities could be assigned to that job. Possibly then, the classification of men into these career fields has taken into account, at a judgmental level, the reading demands of the job.

Table 3.5

Men Scoring Below Grade Seven on the Reading and Arithmetic Tests and Below Score Thirteen on the Listening Test

Literacy Test	Military Occupational Specialties							
	Supply Specialist		Armor Crewman		Repairman		Cook	
	N	Percent	*N*	Percent	*N*	Percent	*N*	Percent
Reading	65	16.1	81	21.0	94	23.7	127	33.3
Arithmetic	118	29.4	156	40.6	146	36.9	151	39.6
Listening	42	10.4	41	10.7	20	5.1	116	30.3

A further index of the differences among the MOSs is the performance on the listening test. Approximately one-third of the Cooks scored 12 or below on this test, as compared to 5 to 10% of the men in the remaining jobs. Differences in terms of arithmetic performance are not pronounced, although Supply again showed the fewest men in the lower skill range. Together, the data of Table 3.5 suggest that the literacy demands may be greatest for Supply, about equal for Armor Crewman and Repairman, and least for Cook. This is consistent with the findings reported earlier in this chapter.

Interrelationships Among Literacy Measures

Table 3.6 presents an intercorrelation matrix for literacy variables, some personal background variables, and the AFQT. Table 3.6 shows that reading, arithmetic, and AFQT, all tests requiring ability, are substantially intercorrelated, which is not surprising since one-quarter of the AFQT is vocabulary and one-quarter arithmetic word problems.

[4] Office of Secretary of Defense, Assistant Secretary of Defense (Manpower and Reserve Affairs. "Project One Hundred Thousand: Characteristics and Performance of "New Standards" Men, 1968.

Table 3.6

Intercorrelations of Predictor and Selected Background Variables Summed for Four Army Jobs

Variables	Variables						
	1	2	3	4	5	6	7
1. Reading	–	.69	.65	.54	.30	–.04	–.27
2. Arithmetic	.69	–	.61	.43	.34	–.10	–.22
3. AFQT	.65	.61	–	.47	.26	.01	–.30
4. Listening	.54	.43	.47	–	.12	.00	–.22
5. Education	.30	.34	.26	.12	–	.01	.12
6. Age	–.04	–.10	.01	.00	.01	–	.11
7. Race[a]	–.27	–.22	–.30	–.22	.12	.11	–

[a]For computing the correlations with race, Caucasian was assigned the code number of O, and Negro the code number of 1.

These three tests show similar profiles over the other predictors. Listening, a verbal but non-reading test, presents a somewhat attenuated version of this pattern.

With regard to literacy and personal background factors, Table 3.6 indicates only mild relationships of reading and arithmetic to education in our sample. Age is not correlated to any suggestive extent with any of the other variables, while the mild, negative coefficients for race and the various measures of cognitive skills suggest that English speaking Caucasians score somewhat higher on these language-oriented measures than non-Caucasians or Caucasians from homes where standard English may not be the predominant language.

Interrelationships Among Predictor and Criterion Variables

Table 3.7 presents the intercorrelations of predictor and criterion variables with the latter statistically adjusted to be freed of the effects of time on the job. The supervisor ratings are not related to any of the predictor variables to any meaningful degree. Hence, the prediction of job proficiency when measured by the supervisor's rating is not feasible with any of these predictor variables and will not be treated further in this report.

The data for Job Knowledge scores indicate that, across all four jobs, job knowledge is most closely related to reading and AFQT, and less closely related to arithmetic and listening (with the exception of the Supply MOS). For Job Sample performance, however, all of the literacy variables and the AFQT decrease in predictive precision. Thus, the data indicate that the literacy variables predict job measures which place a heavy demand on reading better than they predict job sample data, which demand little direct application of reading, although general language demands persist.

The correlation coefficients indicate the overall relationships among the predictor and criterion variables. Perhaps a more meaningful and useful indication of the relevance of reading skills for job proficiency may be obtained by considering Figures 3.5, 3.6, 3.7, and 3.8. These figures were constructed for each reading level by determining the percentage of men in that reading level who scored among the bottom 25% (4th quarter), next-to-the bottom 25% (3rd quarter), next-to-the top 25% (2nd quarter), and top 25% (1st quarter) of those who took the tests. Thus, each of the bars shows the proportion of men at that reading level who scored in each of the four quarters of job proficiency. The sum of the proportions in each bar is 100%, which accounts for all of the men at a given reading level.

Table 3.7

Correlations Between Predictors and Job Proficiency Measures

MOS	Predictor	Job Proficiency Index		
		Job Knowledge	Job Performance	Supervisor Ratings
Armor Crewman	AFQT	.55	.37	.07
	Reading	.57	.32	.06
	Arithmetic	.49	.31	.14
	Listening	.53	.29	.06
Repairman	AFQT	.44	.32	.16
	Reading	.47	.26	.17
	Arithmetic	.39	.24	.14
	Listening	.40	.38	.09
Supply Specialist	AFQT	.36	.37	.09
	Reading	.40	.40	.10
	Arithmetic	.34	.36	.09
	Listening	.35	.42	.11
Cook	AFQT	.49	.37	.15
	Reading	.56	.34	.11
	Arithmetic	.44	.31	.13
	Listening	.39	.28	.07

In each figure, the bar at the bottom indicates the proportion of men that would be expected in each quarter (25%) if the correlation of job proficiency and reading was 0. Over-representation in any quarter is indicated by a score greater than 25%, while under-representation is indicated by a score less than 25%. Under- or over-representation, especially in the bottom and top quarters, is expected when the literacy-job proficiency correlation is greater than zero. In Figures 3.5, 3.6, 3.7, and 3.8, the bottom and top quarters are represented by unfilled blocks; while the 3rd and 2nd quarters are striped. The numbers within each division show the proportion of persons at that reading level who are in the designated quarter.

Figure 3.5 (Job Knowledge Proficiency for Armor Crewmen) shows that 98% of the men who read at the 11—14.5 level scored above the median on the knowledge test. Furthermore, 75% were among the best (top quarter) of those who took the Job Knowledge test. Looking at the lowest reading level, the figure shows that only 24% of men in the 4—5.9 reading level scored above the median on the Job Knowledge test. None was in the 1st quarter. On the other hand, 59% of the poorest readers performed among the bottom 25% of their fellow job incumbents who took the knowledge test.

As the foregoing illustrates, by reference to these figures, the probabilities associated with a man's falling in the 4th, 3rd, 2nd, or 1st quarter on the two proficiency tests can be determined as a function of reading ability. For instance, in Supply, the probability is .66 (66 times out of a hundred) that a man who reads in the 4—5.9 level will fall in the bottom quarter of job proficiency when measured by the job sample performance test. These probabilities are, respectively, .38, .31 and .53 in reference to job sample performance in Armor Crewman, Repairman, and Cook. Considering Job Knowledge, these probabilities are: Armor, .59; Repairman, .50; and Cook, .71.

Quarter Distributions of Job Knowledge and Performance by Reading Grade Level: Armor Crewman *(MOS 11E)*

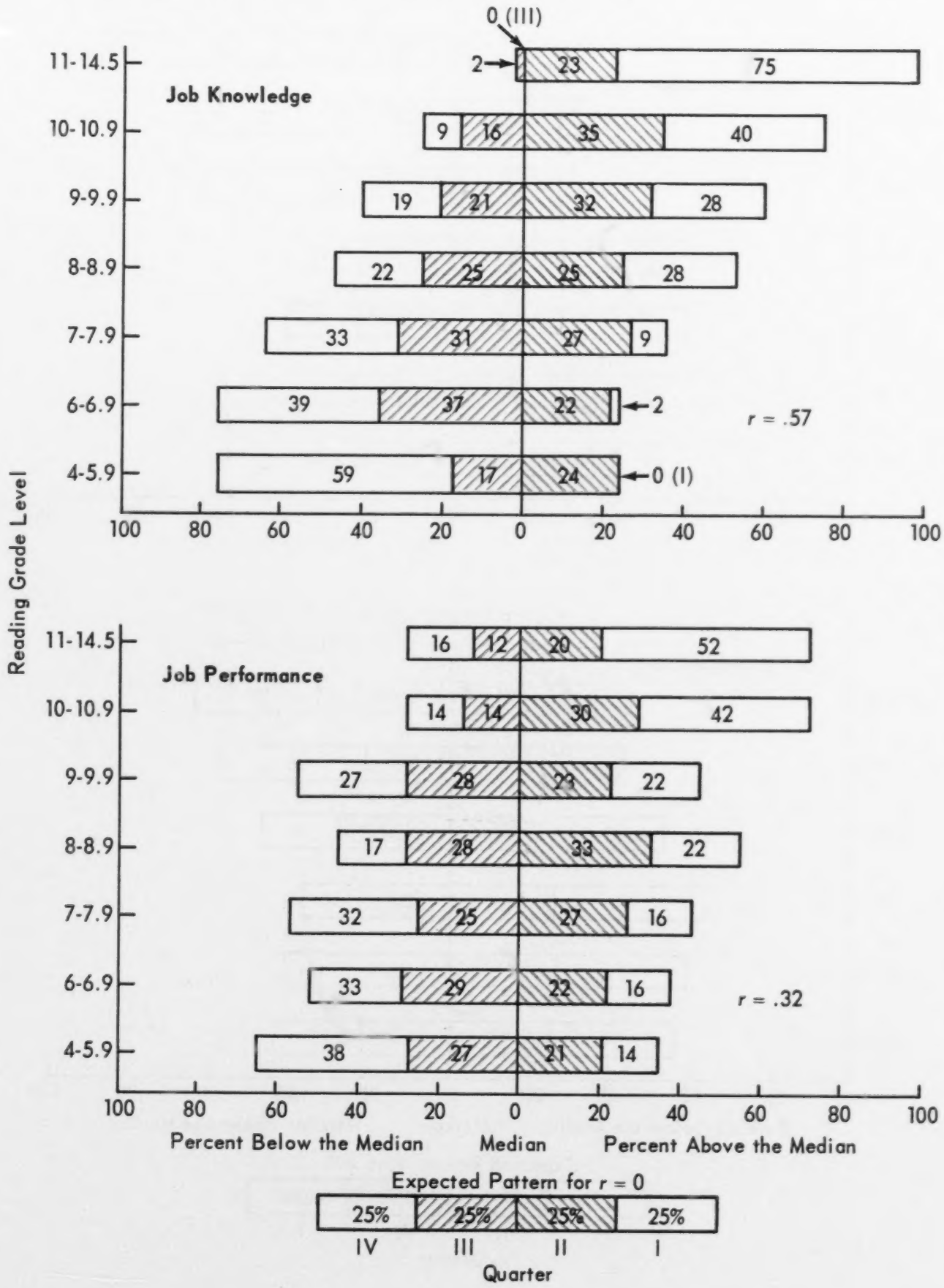


Figure 3.5

Quarter Distributions of Job Knowledge and Performance by Reading Grade Level: Repairman *(MOS 63C)*

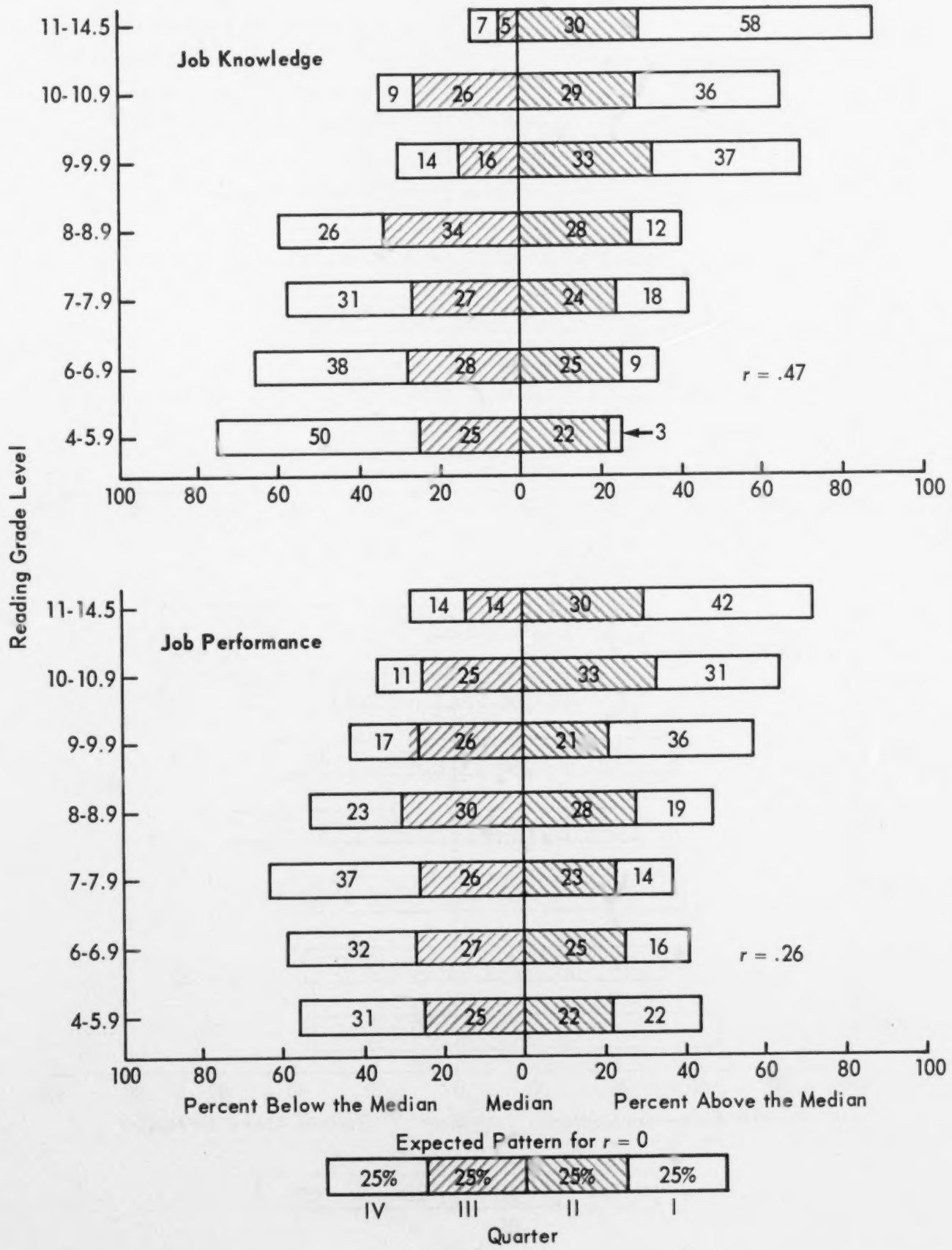


Figure 3.6

Quarter Distributions of Job Knowledge and Performance by Reading Grade Level: Supply Specialist *(MOS 76Y)*

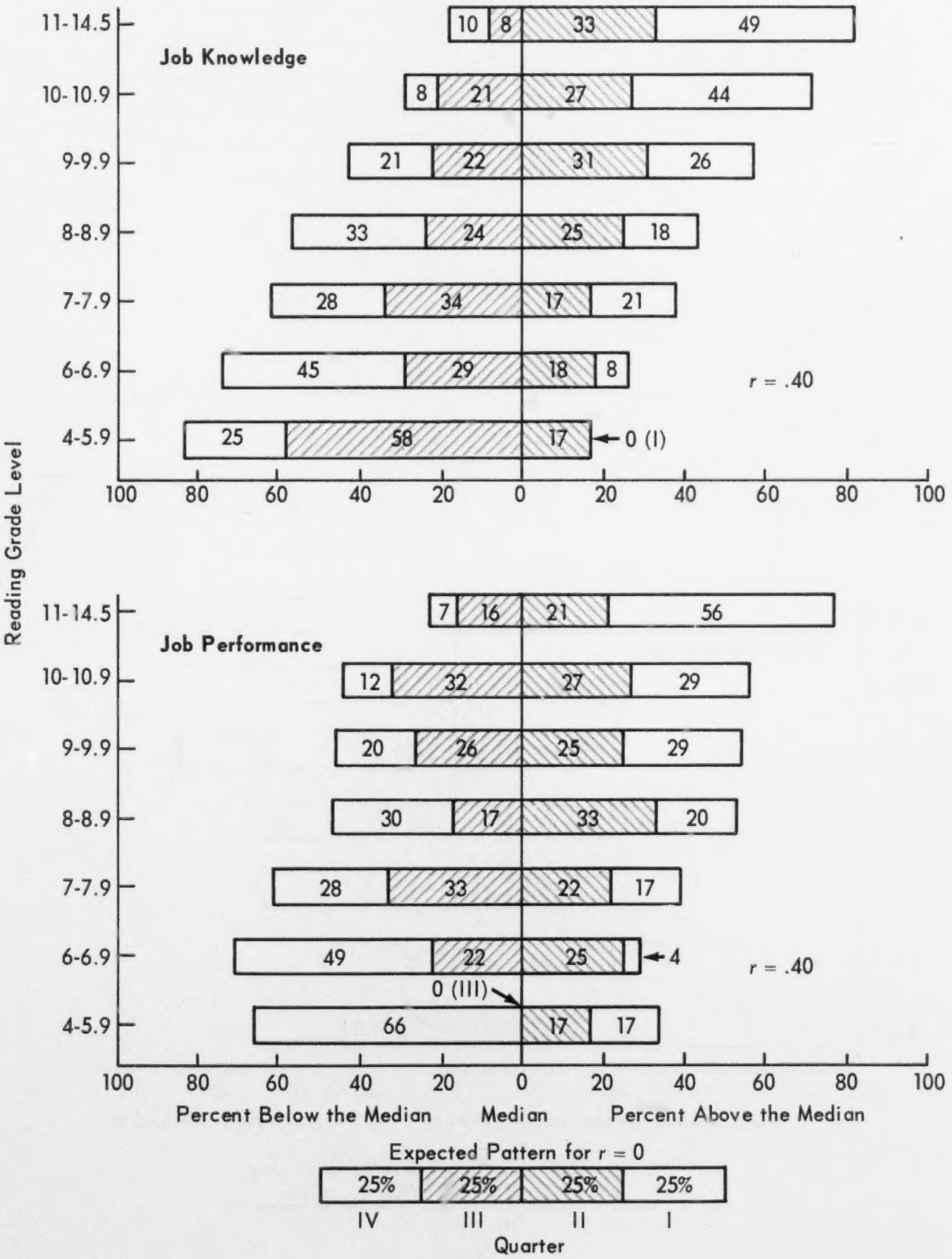


Figure 3.7

Quarter Distributions of Job Knowledge and Performance by Reading Grade Level: Cook *(MOS 94B)*

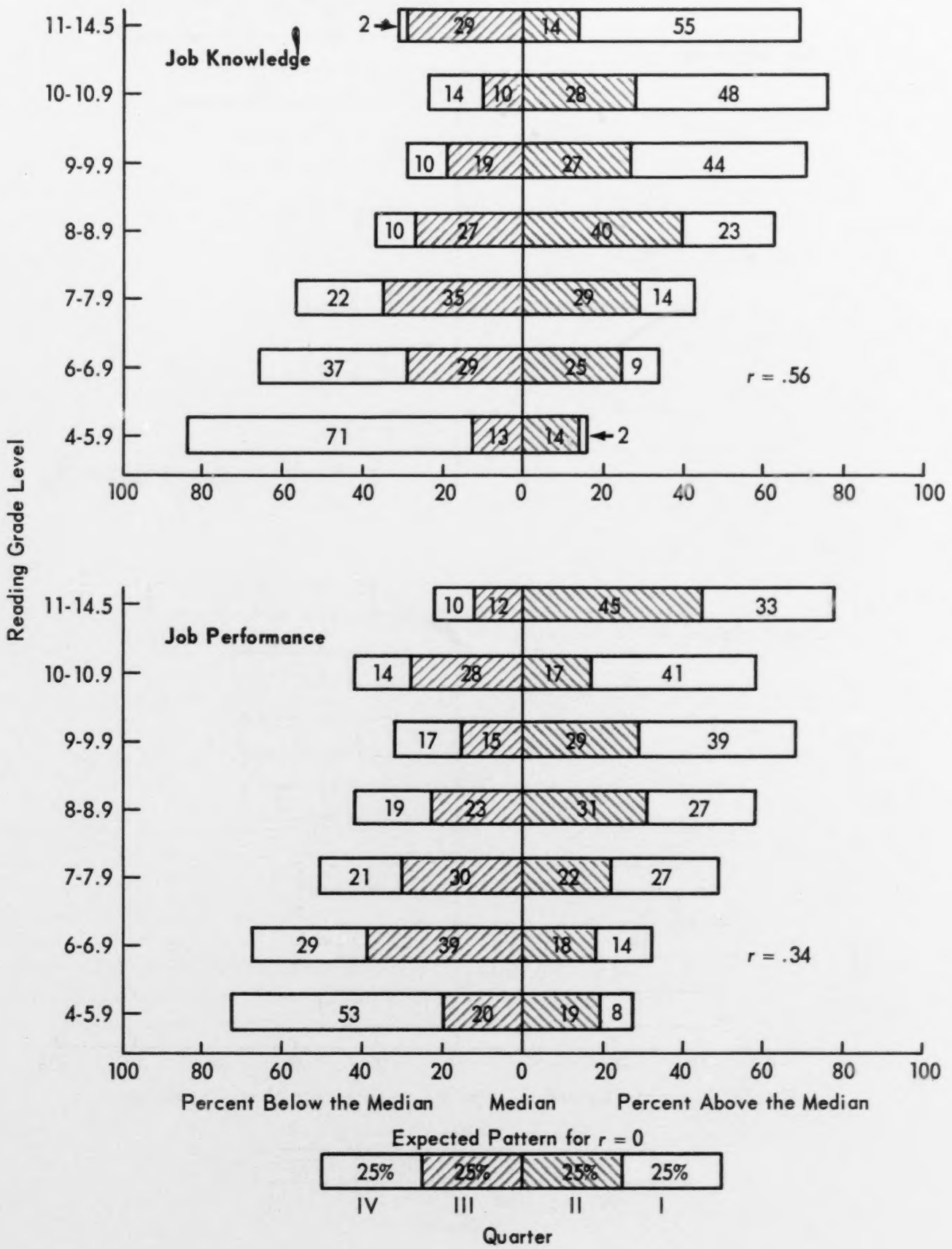


Figure 3.8

Reading Requirements for Four MOSs

In principle, all of the men tested in UTILITY and REALISTIC were successful job performers by virtue of the fact that they were actively serving in a job position at the time of testing. This is somewhat analogous to saying that persons who hold the High School diploma can, by definition, read at the 12th grade level. In actuality, however, a student's reading level is defined in terms of his reading test performance *relative* to other people in the other school grades. In a similar fashion, we can describe *adequate* job proficiency in terms of the relative proficiency of job incumbents. Thus, the data of Figures 3.5, 3.6, 3.7, and 3.8 show relative job proficiency for men at each reading level. That is to say, the men in the bottom quarter are there because their proficiency was poorer than three-fourths of the other men. We find, however, that because of the significant correlations of reading and job proficiency, the different reading levels are disproportionately represented in the four quarters, especially is this true for the top and bottom quarters. As the bar at the bottom of the figures indicates, if there were *no* correlations of reading and job proficiency, we would expect to find 25% of the people at each reading level in the bottom quarter, 25% in the third quarter, and so forth. This suggests a decision rule for determining the reading level to be specified for each job. The rule is to select the lowest reading level for which representation in the bottom quarter does not exceed 25%, that is, the level of representation that would occur if reading ability did not count (r=0).

Applying the above rule to the data for Armor Crewman (Figure 3.5) we find that, for Job Knowledge, 33% of the people who read at the 7—7.9 level are in the bottom quarter, while only 22% of those who read at the 8—8.9 level are in the bottom quarter. Thus, a reading level of approximately 8.0 is indicated as a targeted reading level for the Armor MOS when Job Knowledge is the criterion. Examination of the Job Sample data tends to confirm this level. There we find that 32% of the people reading at the 7—7.9 level are among the bottom job performers, while only 17% of the readers at the 8—8.9 level are in the bottom quarter. Again, then, an 8.0 level of reading appears to prevent over-representation in the bottom quarter.

Similar analyses (with some latitude for anomalies) applied to the Job Knowledge and Job Sample data for Supply Specialists, Repairmen, and Cooks (Figures 3.6, 3.7, 3.8) suggest reading levels of 9.0, 8.0, and 7.0, respectively. It should be noted that these levels rank the jobs in the same order as the reading task test criterion (Figure 3.4). That is, Supply is most demanding of reading skills, the Repairman is next, and the Cook is least demanding. Furthermore, this is consistent with the data of Table 3.5 which shows 16% of the Supply personnel scoring at the 7.0 reading level or below, while 23% of the Repairmen and 33% of the Cooks scored at or below the 7.0 level. This suggests that classification and/or attrition due to job demands has acted to restrict the number of poorer reading men in the Supply and Repairman MOSs.

When similar analyses as above are performed for the arithmetic (Figures 3.9, 3.10, 3.11, 3.12) and listening data (Figures 3.13, 3.14, 3.15, 3.16), the indicated level of arithmetic skills for Repairmen, Supply, and Cooks is 7.0—7.9, while for Armor Crewmen a 6.0—6.9 level appears to suffice. For listening, scores in the 16—18 range appear sufficient to prevent disproportionate representation in the lowest quarter of job proficiency for both Armor Crewmen and Cooks. For Repairmen and Supply Specialists, scores in the 19—21 category appear to be associated with "adequate" job proficiency, as defined by representation in the lowest fourth of job incumbents. The increased demand for listening skill in the Supply and Repairman jobs, in contrast to that for the Cook, is consistent with the differences in reading requirements for these jobs. This suggests a greater need for general language skills in the Supply and Repairman fields.

Quarter Distributions of Job Knowledge and Performance by Arithmetic Grade Level: Armor Crewman *(MOS 11E)*

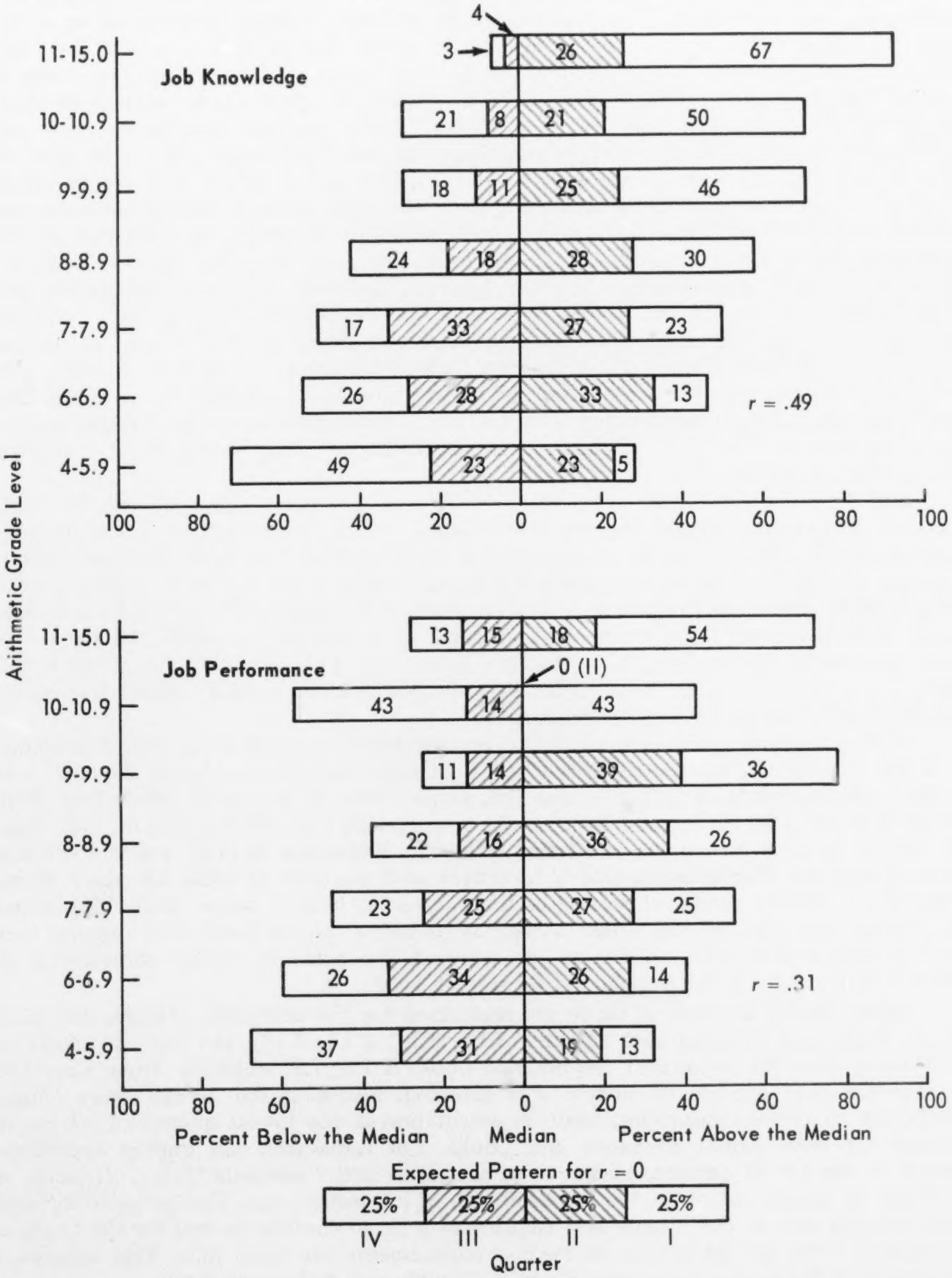


Figure 3.9

Quarter Distributions of Job Knowledge and Performance by Arithmetic Grade Level: Repairman *(MOS 63C)*

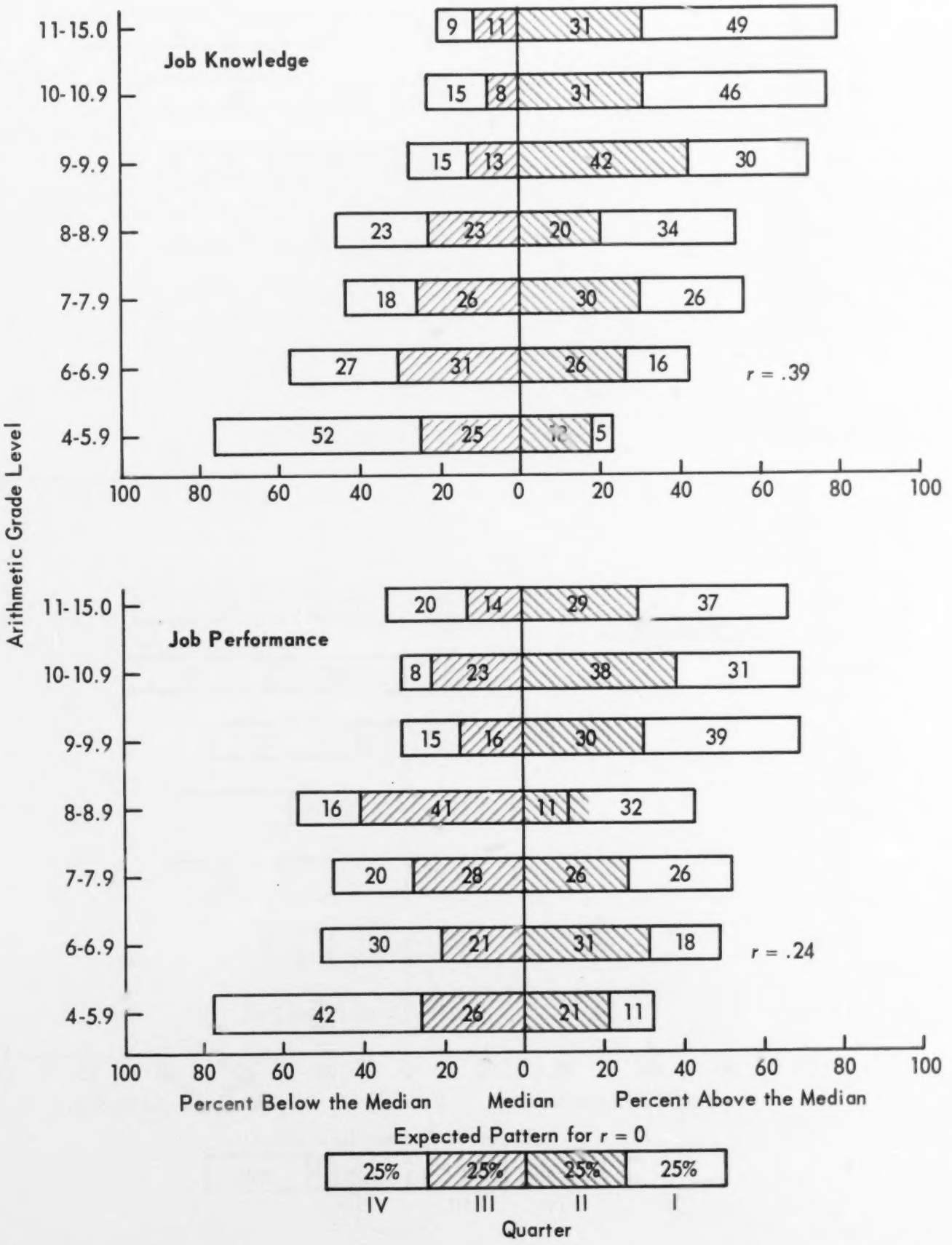


Figure 3.10

Quarter Distributions of Job Knowledge and Performance by Arithmetic Grade Level: Supply Specialist *(MOS 76Y)*

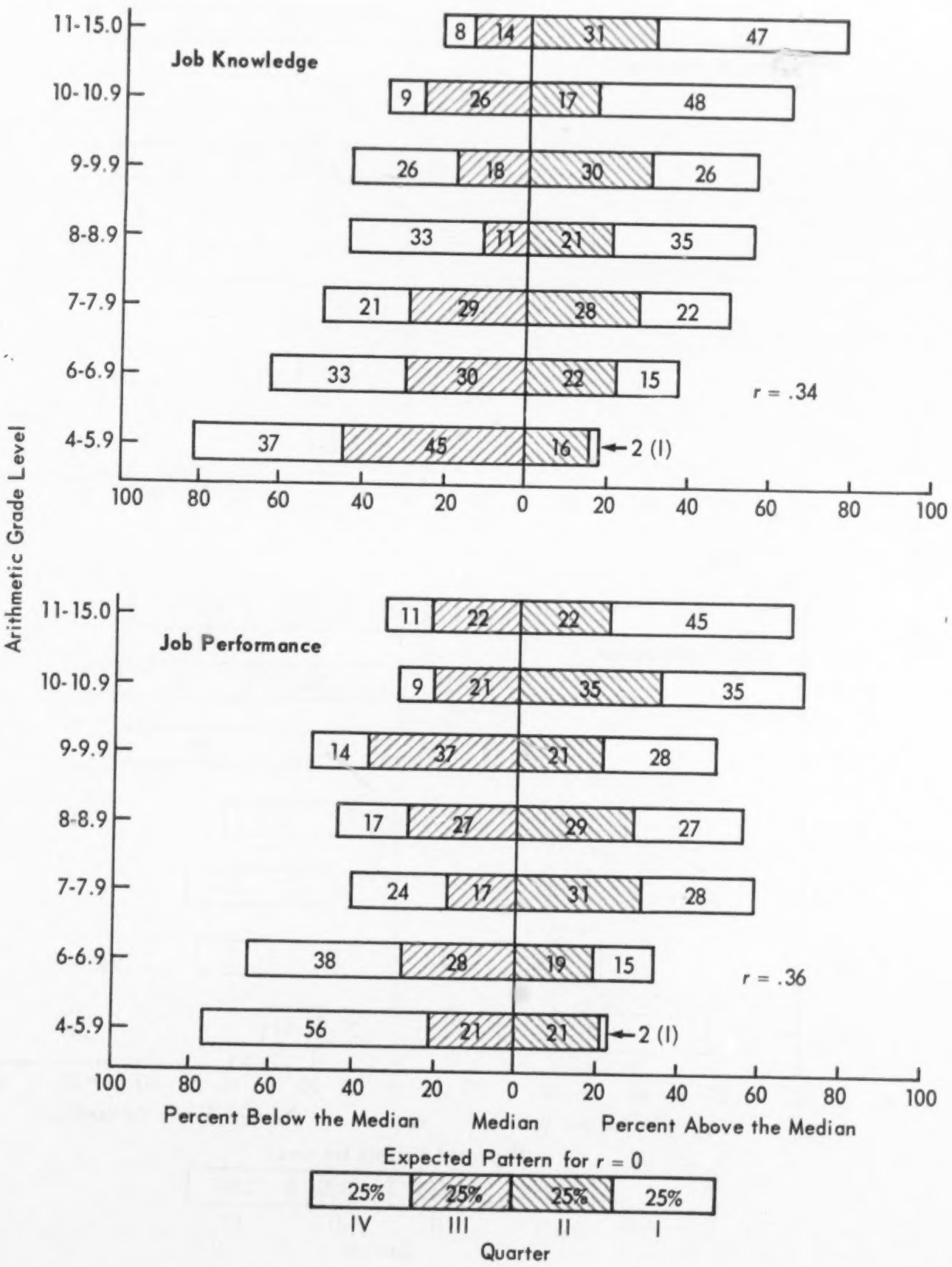


Figure 3.11

Quarter Distributions of Job Knowledge and Performance by Arithmetic Grade Level: Cook *(MOS 94B)*

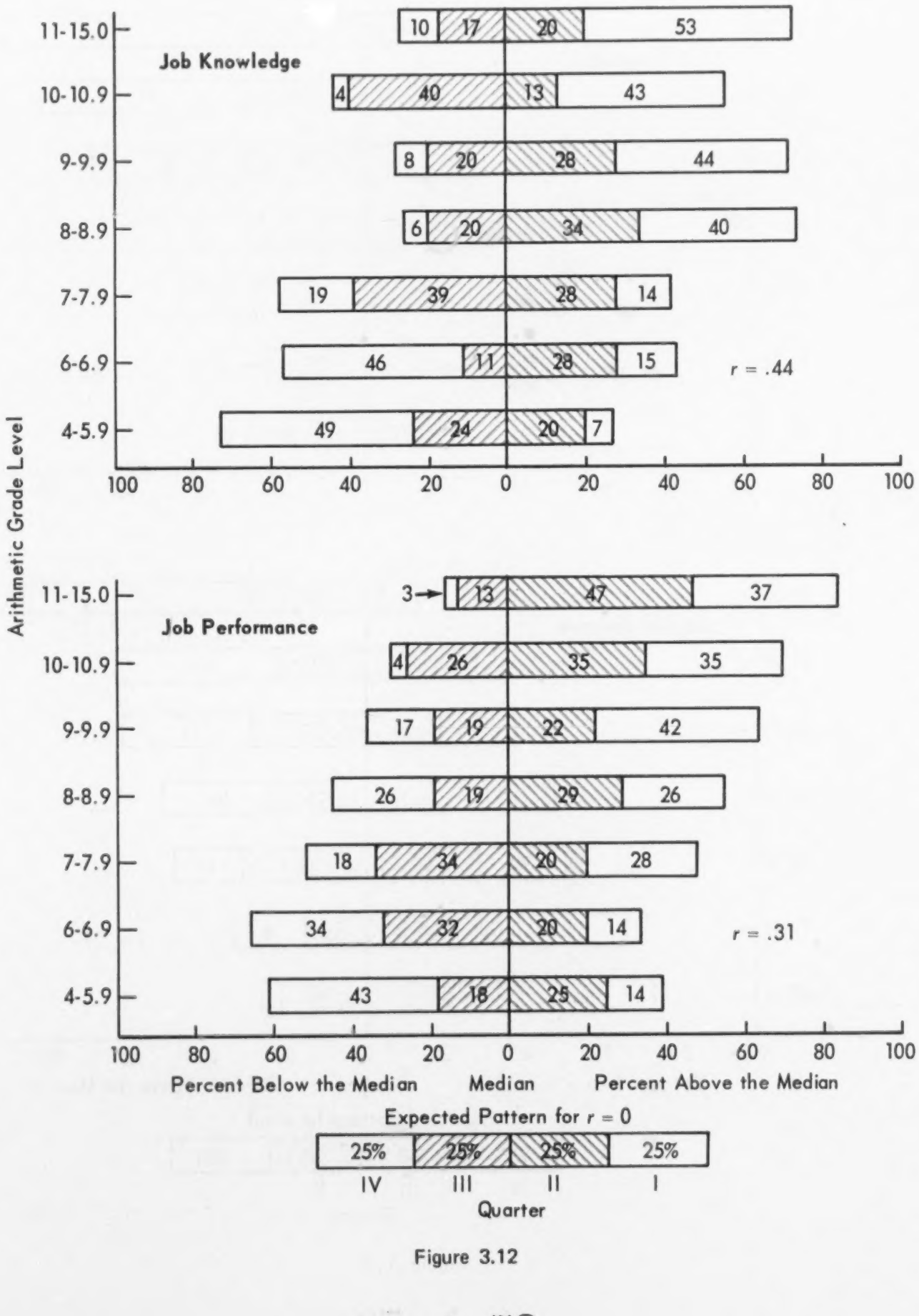


Figure 3.12

Quarter Distributions of Job Knowledge and Performance by Listening Score Level: Armor Crewman *(MOS 11E)*

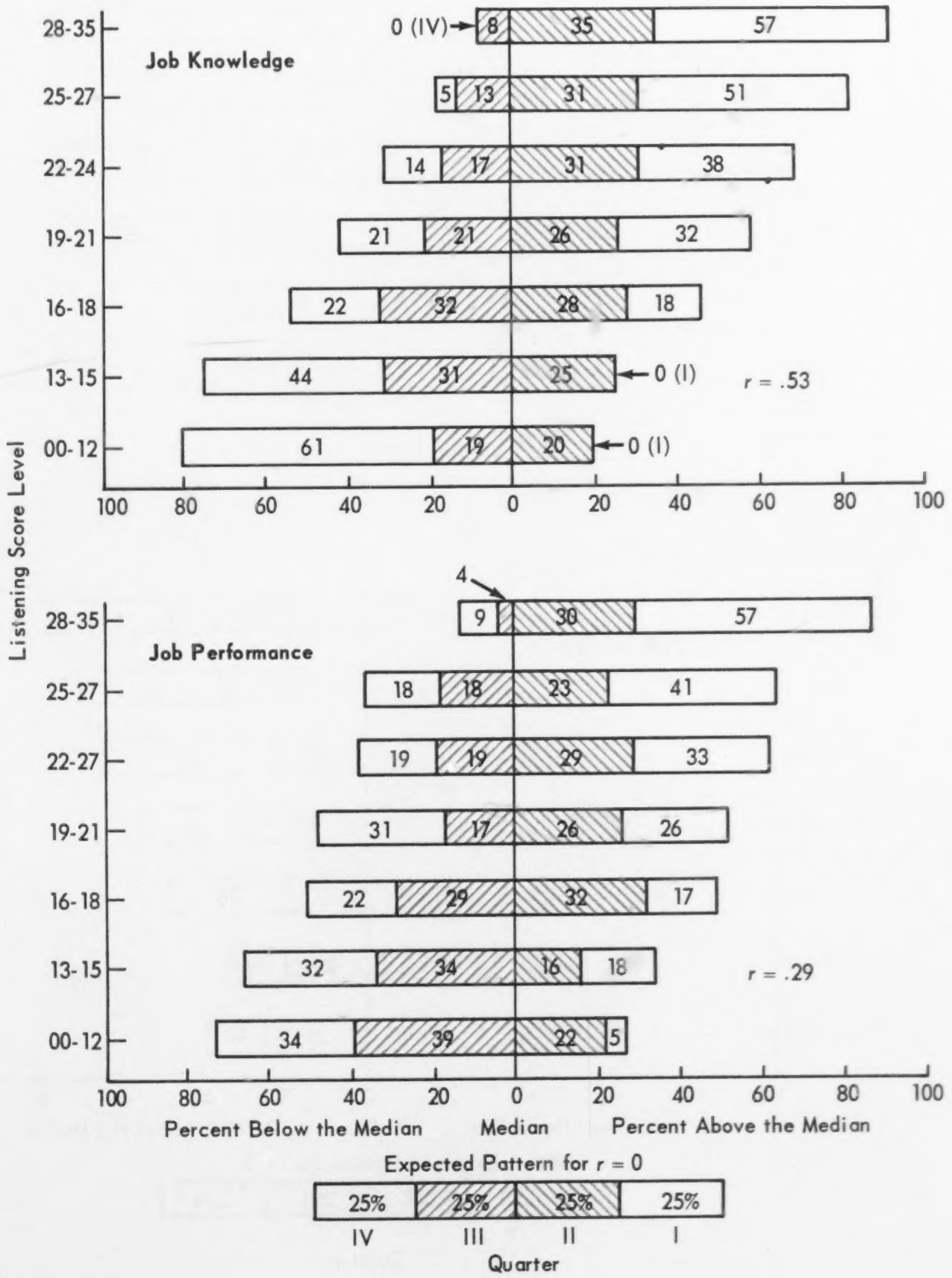


Figure 3.13

Quarter Distributions of Job Knowledge and Performance by Listening Score Level: Repairman *(MOS 63C)*

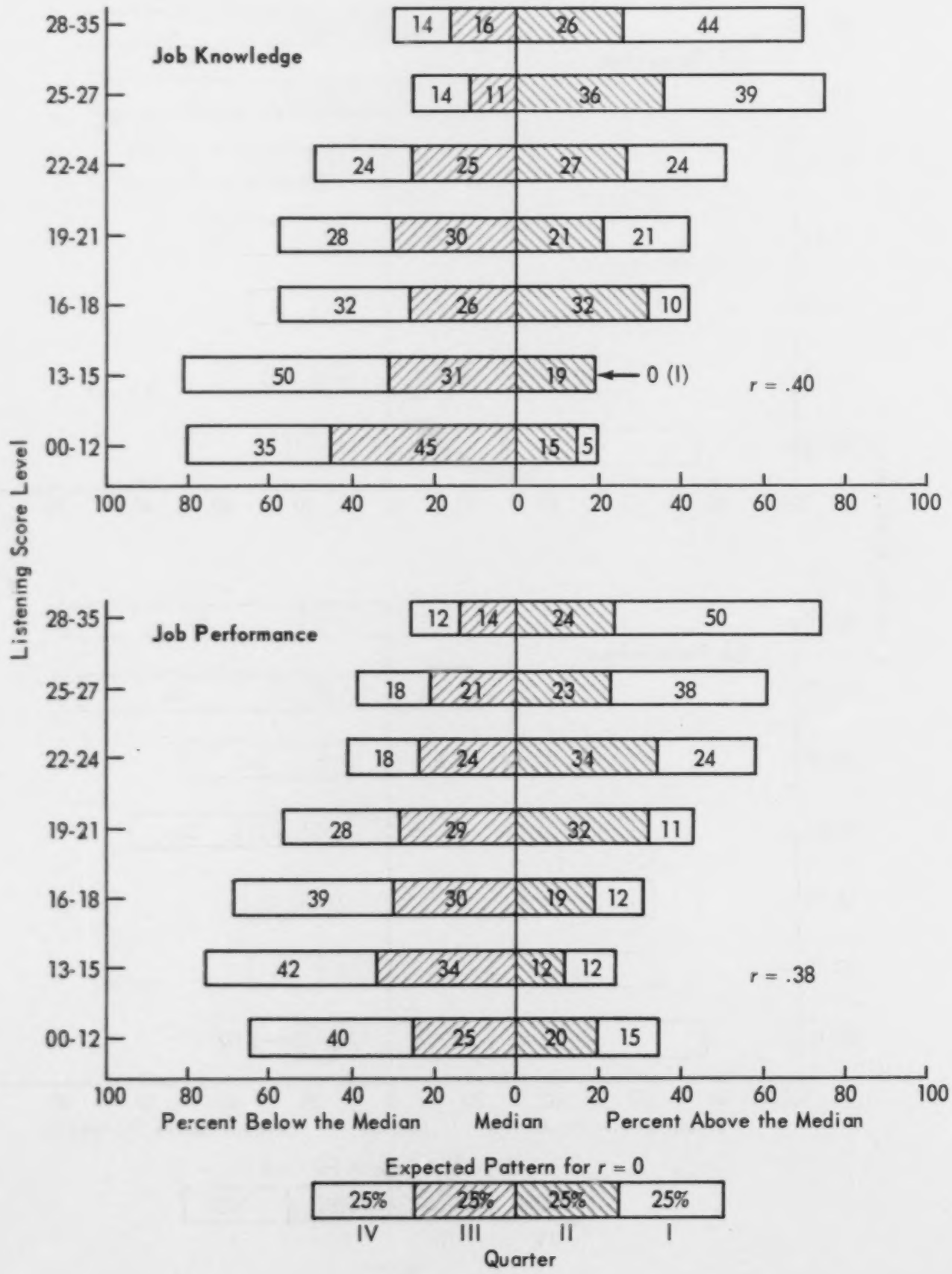


Figure 3.14

Quarter Distributions of Job Knowledge and Performance by Listening Score Level: Supply Specialist *(MOS 76Y)*

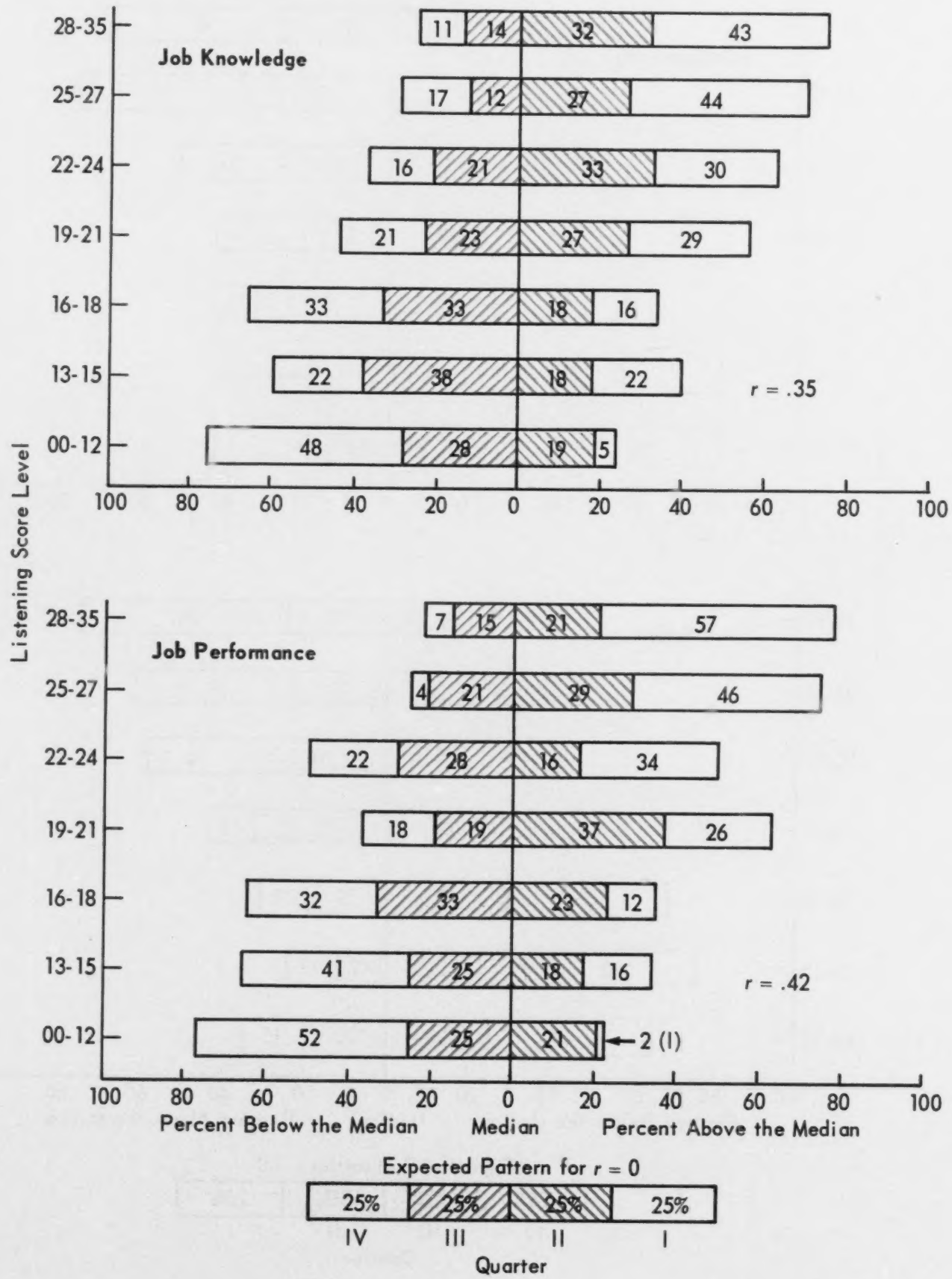


Figure 3.15

Quarter Distributions of Job Knowledge and Performance by Listening Score Level: Cook *(MOS 94B)*

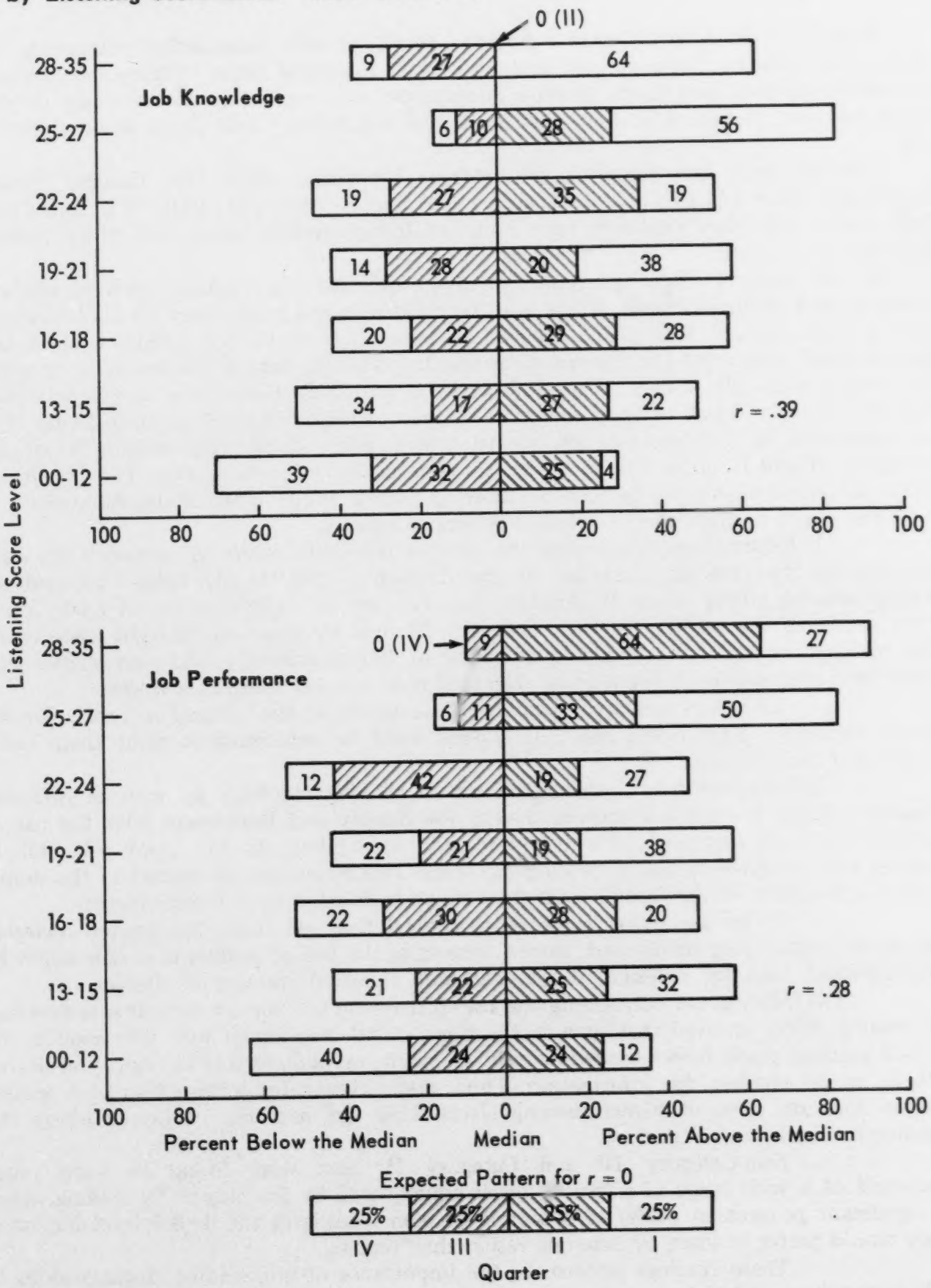


Figure 3.16

SUMMARY AND MAJOR FINDINGS

Work Unit REALISTIC was conducted to (1) provide information concerning the demands for reading, listening, and arithmetic skills in several major Military Occupational Specialties (MOSs), and (2) to provide information and suggestions for reducing discrepancies between personnel literacy skill levels and the literacy skill levels required by the job.

Subjects were men in four jobs—Armor Crewman, MOS 11E; General Vehicle Repairman, MOS 63C; Unit and Organizational Supply Specialist, MOS 76Y; and Cook, 94B. These jobs have relatively high input of lower aptitude men, and hence literacy skills are of concern.

In this chapter, data are reported which indicate relationships between reading, listening, and arithmetic skills of men in the cited jobs and proficiency on (1) job-related reading tasks, (2) Job Knowledge ("paper-and-pencil") tests; (3) Job Sample ("hands-on" performance) tests, and (4) supervisor ratings. In addition, data are presented concerning the reading difficulty level of printed materials in the Cook, Repairman, and Supply jobs, and the extent of usage of these materials by men of different reading ability levels. Data are presented to indicate the extent to which men of differing reading levels ask questions of and listen to others (peers, supervisors) for job information. The extent and nature of use of arithmetic by men of differing reading ability levels is also discussed.

The major findings can be listed in several categories:

(1) Information concerning the *reading difficulty levels* of materials for each job showed that reading materials in the Repairman and Supply fields exceeded the average reading ability levels of Non-Category IV men by some four to six grade levels. They exceeded the reading levels of Category IV men by some six to eight grade levels. The reading materials used by Cooks consisted of recipes primarily, and were written at a grade level comparable to the reading ability of men in both mental categories.

Literature research indicated that much of the printed materials for the Armor Crewman, Repairman, and Supply jobs could be redesigned to make them easier to use and comprehend.

(2) Information concerning the use of *reading materials* by men of different reading abilities in each job showed that in the Supply and Repairman jobs, the use of printed materials increased with increased skill in reading. In the Cook job, skill in reading was unrelated to use of reading materials. This appears to be related to the simple format and syntax of the Cook's references which were cited by job incumbents.

There was some evidence to suggest that the easier the printed material, the more it was likely to be used. Hence, increasing the use of reading materials might be accomplished both by redesign of materials and remedial training in literacy.

(3) Information concerning the use of *listening sources* on the job as a function of reading ability showed that men in the Supply and Repairman jobs who read at the 4—6.9 reading grade levels tended to rely as much, or perhaps a little more, on asking others, as on reading, for information. Thus, they listened for information to a greater degree than did men of higher reading levels. This was not true of Cooks where the reading materials were easiest.

Non-Category IV and Category IV men were found to learn prose materials of a wide range of difficulty levels equally well by listening as by reading. Also, a significant proportion (49%) of a sample of men reading at the 4—6.9 level indicated they would prefer to learn by listening rather than reading.

These findings underscore the importance of non-reading language skills in job performance. Listening as a communication skill is being further studied in HumRRO Work Unit LISTEN.

(4) Information concerning the *use of arithmetic* on the job as a function of reading ability was obtained by interviews with job incumbents in the Repairman, Supply, and Cook jobs where very little use of arithmetic was indicated. However, where used in Repairman and Supply, it was greater for higher reading ability men. This was not true for Cooks.

Lower reading level (4—6.9) men in the Supply and Repairman MOSs tended to use mostly whole numbers or gauges in their arithmetic, while higher reading ability men used more complex arithmetic (fractions, decimals). It appears that men with better reading skills perform, in general, more "responsible" jobs, where precision and accountability are demanded, and, hence, use more complicated arithmetic. However, we found no demand for arithmetic skills beyond what is ordinarily taught at the 6th grade level.

(5) Information concerning *reading ability and proficiency on job-related reading task tests* showed that performance of men new to the Army on job-related reading task tests for Repairman, Supply, and Cook correlated approximately .76 with performance on the standardized grade school referenced reading test (SRT). This correlation was .65 for job reading task test and AFQT. Thus, the SRT was a better predictor of proficiency on job-related materials than the AFQT was.

(6) Information concerning *reading, listening, and arithmetic skills* and proficiency on Job Knowledge and Job Sample performance tests, and supervisor ratings showed that only inconsequential relationships of any of the literacy variables to supervisor ratings were found for any MOS. The reading test score and AFQT appeared to measure the same thing to a large degree. Both predicted job proficiency equally as well in all four MOSs. Thus, if the purpose of a cognitive test is simply to predict future job proficiency as measured by job knowledge or job sample scores, the AFQT is adequate. However, the SRT predicted job knowledge and job sample performance about as well as the AFQT did and, in addition, the SRT predicted performance on the job reading tasks. The SRT thus out-performs the AFQT by predicting proficiency in a skill used in the job—job-related reading. In addition, the SRT presents *two* items of information: whether or not a person exceeds some minimal cut-off point, *and* how far below or above a man is with respect to some targeted reading level for different MOSs.

Relationships of reading to job proficiency suggested a targeted reading level for Cooks of 7.0; for Repairmen and Armor Crewmen, 8.0; and for Supply, 9.0. These figures assume the job printed materials and job training procedures existing at the time of the study. If considerable alterations to job materials and training procedures were accomplished, it is likely that the job proficiency of men reading below the above levels could be improved. However, if career advancement is desired, so that a man is expected to assume a supervisor's role, then remedial literacy training at least to the levels indicated would be desirable to render general Army and DoD publications useful to the man.

Arithmetic skill is highly related to reading and AFQT and predicts job knowledge and job performance about as well as these other indices. For selection or remedial training criterion purposes, a 5th to 6th grade level would seem sufficient.

Listening and job knowledge were less highly related than reading and AFQT with job knowledge. However, listening was as highly related to job sample performance as were the reading test and AFQT. These findings affirm the importance of listening indicated above.

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1 CG USA TNG CTR ATTN ACOFS G3 FT JACKSON
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1 COMDT NATL WAR COLL FT MCNAIR ATTN CLASSF RECORDS BR LIB
1 COMDT INDSTR COLL OF THE ARMED FORCES FT MCNAIR
1 COMDT USA MGT SCH FT BELVOIR
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1 DIR COMPANY TACTICS DEPT USAIS FT BENNING
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